

THE

ELECTRICAL REVIEW

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THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XVI.—No. 393.

SIXPENNY TELEGRAMS.

ERE this journal is in the hands of its readers the long-delayed debate upon the Telegraph Acts Amendment Bill, introduced by the Postmaster-General, will probably have taken place. It is a matter of some doubt at the moment of writing whether the Bill will be accepted by the House or whether Lord John Manners' amendment will receive approval. Notwithstanding the explicit statements which have already been made by Mr. Shaw-Lefevre there are not wanting those who persistently clamour, regardless of consequences, for a much greater reduction in the charge for telegrams than it is possible for the Department to grant without incurring a disastrous loss. We had hoped as earnestly as any that a system of sixpenny telegrams which could be freely made use of—more freely than will be possible under Mr. Shaw-Lefevre's scheme—would be established; but in the face of the clear and simple explanations which have been offered, we feel it would be folly not to accept the best that can be honestly offered. Since the first declarations upon the subject made by Mr. Shaw-Lefevre we have unhesitatingly given in our support to the principle of his scheme. But then, as now, we pointed out that there were possibilities of adaptation and modification which might render the sixpenny telegram a much greater benefit than seemed likely upon the face of it. Very few of the suggestions that have been publicly offered to the Postmaster-General have contained the elements necessary to commend them to his judgment; they have, for the most part, ignored the principles which alone could ensure their consideration by the department, and have been, however plausible in seeming upon paper, altogether impossible of practical application. Of a different stamp to these is the proposal of Dr. Cameron, M.P. for Glasgow, which is fully set out in our other columns. Anything emanating from Dr. Cameron upon this topic must ensure attention, for not only is he himself conversant with telegraphic matters by reason of his past experience, but to his action two years ago in proposing the resolution approving the principle of sixpenny telegrams, which was then passed by the House of Commons, is the introduction of the Bill now under consideration due. We will not proceed to a discussion of his suggestions, but will merely call our readers' attention to his letter to the *Times*, which appears on another page of this journal. They are not the visionary and fantastical schemes of one who would pose as a public benefactor, but the suggestions of a practical man, and we trust to learn that they have received that attention and consideration which are their due.

THE WATER-VOLTMETER FOR MEASURING ELECTRIC CURRENTS.

AMIDST the frequently recurring occasions and the manifold recent attempts to make strong currents simply and absolutely measurable, the oldest means for this purpose, the common water-voltmeter, has met with little attention. The reason for this neglect may principally be found in the circumstance that the separate collection of the hydrogen, which certainly furnishes a good means for the measurement of the current, cannot be effected without the introduction of a considerable resistance, which is troublesome on account of the heat evolved by the current. The joint collection of both gases involves, as it is believed, a loss of gas depending on the formation of ozone, hydrogen peroxide and hyper-sulphuric acid, and which, as Richarz has lately shown, may under certain circumstances prove very considerable.

On the other hand, the copper or silver voltameters often used of late cannot be acquitted of certain inconvenient properties. The silver voltmeter on the small scale to which it will generally be limited introduces a great resistance, which varies much with the temperature. Hence it is adopted for feeble currents only. The rapid excretion of the precipitate of silver which sets in, especially in case of powerful currents, necessitates this restriction. Powerful currents may indeed be made measurable by taking off merely a branch of the current, as it was done, *e.g.*, by Dorn and Kittler, on the occasion of the Munich electro-technical experiments. But this involves complications which render the process not suitable for everyone. The long duration of the experiments is also an inconvenience.

The copper-voltmeter can without expense be made of larger dimensions; it offers a smaller resistance, and it can be applied to stronger currents. But, as H. Hammerl shows, we cannot at the outside exceed 7 ampères per square decimeter, and even here certain precautions are needed. There is an additional evil, which I have seen nowhere mentioned. On use there often arises in the copper voltmeter a hindrance to the current, evidently due to the resistance of a layer of peroxide deposited upon the copper anode.

I have repeatedly observed, says Prof. F. Kohlrausch in *Elektrotech. Zeitschrift*, that the strength of the current, which was fairly constant at the outset, began suddenly to fall after a time, and in a short time went down to less than the half. Machine currents fell off even more strongly, *e.g.*, from 17 to 3 ampères. If the machine was short-circuited for a moment there was heard a hissing noise through the copper voltmeter, and the coating of peroxide was thrown off at the corners of the anode. The current, however, soon sank again. In course of time, when the coating had shelled off from the entire anode, the strength of the current rose again slowly. This phenomenon had nothing to do with an exhaustion of the solution at the cathode, for even with feeble currents a subsequent sudden decline of the strength of the current was observed. With an active anode surface of 160 square decimetres this took place when about 1.5 gm. of copper had been precipitated.

Even disregarding these difficulties, considerable caution must be used in measurements with the copper voltmeter, if the result is to be trustworthy; a good balance is especially needful, which is not in all cases at hand.

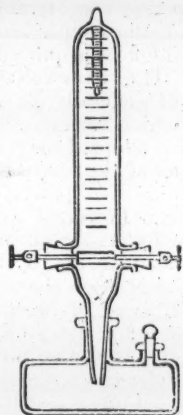
The detonating gas voltmeter, as is well known, introduces a counter-electromotive force of about 2 volts into the circuit, but it is tolerably constant. The resistance can, if desired, be restricted to $\frac{1}{30}$ ohm, so that even with a strength of current of 50 or 100 ampères no considerable liberation of heat ensues.

I have therefore examined whether the sources of error in the detonating gas voltmeter are really so great as to exclude the instrument from the ranks of accurate measuring apparatus, and I have found that for currents which are fairly strong the results are very favourable. Before proceeding to demonstrate this last

proposition, I will describe a convenient form of voltmeter suitable for currents up to 30 amperes, and which on a larger scale can easily be adapted to 100 amperes. Further will be given a convenient process for reducing the measured volumes of gas into the strengths of the current.

Voltmeter.

A glass tube about 40 millimetres in width is graduated into degrees of 5 cc., amounting altogether to 100 cc. A narrowed prolongation of the tube is ground into the neck of a broad, strong vessel, containing fully 500 cc., and serving as a firm pedestal. As in De la Rive's voltmeter (Wiedemann's Electricity II., 1883, p. 489), it is merely necessary to invert the apparatus in order to fill the tube with liquid. The lateral aperture of the supporting vessel is closed during inversion with a ground stopper.



During the experiment a loose cover is naturally substituted for this stopper.

A small thermometer, sealed into the measuring tube, enables the temperature to be observed accurately and conveniently.

The platinum electrodes are introduced through the lateral projections by means of perforated caoutchouc stoppers.

One electrode is a plate of 17 mm. wide and 40 mm. in length, and is enclosed by two plates of the same size which together form the other electrode. The distance between the two electrodes is about 3 mm. on each side.

As a matter of course, the surfaces of the electrodes during use are not horizontal, as shown in the figure, but perpendicular.

The current is conducted to the electrodes by tubes of platinum 30 mm. in length, passing through the caoutchouc stoppers. These tubes are closed up inwardly, and are soldered with gold to the plates of the electrodes. On the outside they are open. Closely fitting conducting wires of copper, provided with clamps, are passed into these tubes. Or the wires may be soldered to the tubes.

The instrument was made by O. Wiegand, glass-blower, of Würzburg.

For filling the apparatus I use pure sulphuric acid at 20 per cent. (1.14 spec. gr.) the conductivity of which falls short of the maximum only by 10 per cent.

The most conductive sulphuric acid (31 per cent.) would effect no very marked improvement in the conductivity, but would inconveniently increase the strength of the acid. It is also stated that the losses of gas by the secondary reactions are rendered more considerable by stronger acids.

As regards this last point it must be remarked that the electrodes consist of ordinary bright sheet platinum. It might be well to amalgamate and anneal the electrodes, by which means, according to Bunsen, the catalytic action of the platinum is abolished.

This precaution is to be recommended on account of the danger of explosions which may occur in case of very strong electromotive powers. Differences of ten-

sion of great moment, however, never occur as long as the electrodes have a stratum of liquid between them.

Reduction of the measured volumes of gas to strength of current.

The volumes require a correction for temperature and pressure. In order to obtain an accuracy of half per cent. the temperatures must be known to 1° C., and the pressure to about 4 mm. of mercury. I assume, therefore, that the observer possesses an aneroid barometer the reading of which may be sufficiently controlled by comparison with the instrument of a weather-glass or by the meteorological reports in the newspapers.

From the height of the barometer, b , during the observation there must first be deducted the pressure in the raised column of sulphuric acid. If the surface of the measuring tube is h mm. higher than the surface in the foot vessel, there must be deducted from the degree of the barometer (since 1.14 and 13.6 are respectively the spec. gravities of the sulphuric acid and the mercury) $h \times 1.14 : 13.6$ or $\frac{1}{12} h$.

The pressure thus reduced is called p , consequently $p = b - \frac{1}{12} h$.

It is now observed, e.g., that for the temperature $t = 20^\circ$ and the pressure $p = 725$ mm. with a current of one ampère there has been evolved per second exactly $\frac{1}{5}$ cc. of (moist) detonating gas. As these are about the average relations we may lay down approximately the proposition:

A current of one ampère evolves in one second $\frac{1}{5}$ cc. detonating gas. Or:

The cc. of detonating gas liberated in a second must be multiplied by 5 to obtain the strength of the current in amperes.

Here, however, in the most unfavourable case there may occur errors up to 10 per cent. To measure accurately we must refer to the following table which shows for the temperature t and the pressure p how many thousandths of a cc. must be added to (or respectively deducted from) every observed cc. in order to reduce the volume to those conditions in which exactly 5 amperes correspond to the volume of 1 cc. per second.

EXAMPLE.

Degree of barometer ... 754 mm.
Height of the acid ... 112 "
Therefore $p = 754 - \frac{112}{12} = 745$ "

Temperature t ... = 17.8°
Vol. of gas observed ... 198.0 cc.
Correction per table + 0.038.198 = + 7.5 "

Reduced volume ... 205.5 cc.
Duration of current ... 39.0 sec.
Evolved in one second $\frac{205.5}{39.0} = 5.27$ cc. pr. sec.
Strength of current $5 \times 5.27 = 26.3$ amp.

t	$p = 700$ mm.	710 mm.	720 mm.	730. mm.	740 mm.	750 mm.	760 mm.
10°	+ 9	24	38	53	68	82	97
11	+ 5	19	33	48	63	78	93
12	+ 1	15	29	44	59	73	88
13	- 4	+ 10	24	39	54	69	83
14	- 8	+ 6	20	35	49	64	78
15°	- 13	+ 2	16	30	44	59	73
16	- 17	- 3	+ 11	26	40	54	68
17	- 22	- 7	+ 7	21	35	49	63
18	- 26	- 12	+ 2	16	30	45	59
19	- 31	- 17	- 3	+ 11	26	40	54
20°	- 35	- 21	- 7	+ 7	21	35	49
21	- 40	- 26	- 12	+ 2	16	30	44
22	- 44	- 31	- 17	- 3	+ 11	25	39
23	- 49	- 35	- 22	- 8	+ 6	20	34
24	- 54	- 40	- 26	- 12	+ 1	15	+ 29
25°	- 58	- 45	- 31	- 17	- 4	+ 10	+ 24

COMPARATIVE MEASUREMENTS.

1. Comparison of the detonating gas voltameter with the copper voltameter.

The latter instrument consisted of a cathode of twice 120 square centimetres between a double anode of each 70 square centimetres, the latter consisting of electrolytic copper. The liquid was a concentrated solution of Tromsдорff's purest sulphate of copper.

The cathode was weighed, and immediately after the experiment it was quickly rinsed, and dried first between blotting paper and then in the air pump. The initial increase of weight on withdrawal from the air pump was about a milligramme. After a quarter of an hour the weight of the copper plate remained constant for days.

As a source of the current were used Bunsen elements, or accumulators, or a Siemens dynamo.

The volume of detonating gas, reduced according to the table, was re-calculated into the equivalent quantity of copper in milligrammes by multiplication with 1.640 (since 1 ampère separates out per second 0.328 mgr. copper, or 0.2 cc. detonating gas).

In order to obtain a larger quantity of copper the gas voltameter was repeatedly filled during an experiment.

In the first column is given the approximate strength of the current in ampères as read off on a spring galvanometer.

The partially considerable decrease of the current during the experiment has been already discussed.

Strength of Current.	Temperature. <i>t</i> Degrees.	Pressure. <i>p</i> mm.	Volume.		Quantity of Copper.			Deviations in per cents.
			Observed. ccm.	Reduced. ccm.	Calculated. mg.	Observed. mg.	Calculated - observed. mg.	
3 Ampère	14.2	727	390	401.5	658	660	+ 2	+ 0.3
3 to 4	16.7	726	576	585.5	960	964	+ 4	+ 0.4
8	17.0	727	572	582.9	956	954	- 2	- 0.2
11	16.1	726	560	571.1	937	935	- 2	- 0.2
17 to 3	17.8	725	551	556.5	913	916	+ 3	+ 0.3
18 „ 3	18.1	720	577	577.8	948	950	+ 2	+ 0.2
29 „ 10	17.8	717	286.4	286.3	469	471	+ 3	+ 0.4

The greatest variation amounts to 4 milligrammes, at which the deposit of copper observed was greater than the quantity calculated from the gas voltameter. In the mean the calculated quantity of copper is too small by about $\frac{1}{3}$ per cent.

2. Comparison of the Detonating Gas Voltameter with the Tangent Galvanometer.

The second series of experiments was not less satisfactory. The strength of terrestrial magnetism at the place of observation was known. Hence the reduction factor of the tangent galvanometer, which had been very accurately measured, was calculated as 6.22. For safety's sake the value was also ascertained by the introduction of a copper voltameter. Different measurements gave:

6.21 6.23 6.25.

So that we may put as a mean:

$$i = 6.23 \times \tan. \phi \text{ ampère.}$$

The application of a shunt gave the factor 32.01.

The current closed by this tangent galvanometer and by the detonating gas voltameter was closed and opened at the stroke of a seconds-clock, and the two points of the needle were read off every 15 seconds. Dr. Kreichgauer assisted me in the observations.

In order not to give too many figures I will merely give the means of groups of the 20 measurements made with currents of nearly equal strengths. I made the observations with both instruments, calculating both into ampères:—

Tang. galvan. ... 31.03; 25.24; 10.89; 8.03; 5.50.

Gas voltameter... 31.02; 25.15; 10.95; 7.91; 5.53.

Difference + 0.01; + 0.09; - 0.06; + 0.12; - 0.03.

As a mean the strengths of the current were found about one seventh per cent. lower with the gas voltameter than with the tangent galvanometer.

We find, therefore, in both series the results of the detonating gas voltameter rather too small, as was to be expected. The differences, however, are so small—not larger than experimental errors—that the instrument above described can be very conveniently used for measuring the strengths of currents from 3 to 30 or even 50 ampères, which for technical purposes may be sufficient.

That a voltameter, even the most convenient, cannot commonly be applied for the measurement of currents is plain. But it seems to be that for gauging or checking galvanometers for powerful currents there is no better means than the detonating gas voltameter. Even when we are in a position to work with a trustworthy constant galvanometer, such as the tangent galvanometer, the reduction factor of the latter instrument can nearly always be determined with more accuracy by means of the voltameter than from the terrestrial magnetism and the dimensions of the current.

The measuring instruments (such as that of Deprez) depending on constant magnetism are quite untrustworthy without a frequent control. The dynamometer of Siemens and Halske, and the instruments which measure with soft iron (*e.g.*, the spring-current balance which I have described) afford a much greater permanence. But a simple method of testing the constancy of the results or the accuracy of the gauging must always be desirable.

Even when strong currents are measured with the application of a shunt, say with Siemens and Halske's torsion galvanometer or the mirror galvanometer of Dorn and Kittler, I incline to the opinion that determinations by the measurement of the entire current are often preferable to the determination of the shunt relation from the resistance. Certainly they are simpler.

In order to measure with accuracy stronger currents than those used above, the volume of the measuring cylinder must be increased. This can be effected by means of a globular expansion at the upper end of the cylinder in order to prevent an inconvenient height of the instrument, and the risk of inaccuracy in reading off the results. Otherwise the duration of the experiment would be too short, and errors in making and breaking contact at the right moment would interfere with accuracy. The contact is effected by means of a cup of mercury or a lever, which can be worked with accuracy. It is not difficult to work accurately to $\frac{1}{10}$ second by the beat of a seconds-clock, so that the prolongation of the current for half a minute excludes errors of 1 per cent. With a measuring cylinder of 500 cc. satisfactory results can be obtained up to 100 ampères, and so on in proportion.

In setting up the voltameter care must be taken to place the measuring tube perpendicular by sighting a window-cross, &c. The volume is read off very accurately at the lower level.

AN AUTOMATIC COMMUTATOR FOR
JABLOCHKOFF CANDLES.

NUMEROUS automatic devices have been invented for changing a burnt out Jablochkoff candle for a fresh one, but these have not met with any extended application, although the general employment of electric candles appears to us to depend very much upon their use. A system devised by M. L. Robenrieth is thus described by him in a recent issue of *La Lumière Electrique*:—

Of all the systems of electric lighting with the voltaic arc, the Jablochkoff candle is, in our opinion, the most practical. No regulator can be compared with it for simplicity and security, especially since the candles can be placed in derivation in each group, and

the change effected automatically when they are used up or extinguished. In this manner all superintendence becomes unnecessary, the hand commutators with their wires are superseded, the candles are utilised up to the very end, and we can obtain lighting for as long a time as is desired.

To place candles of different resistances in an electric circuit, and to say that the current shall first ignite the least resisting, seems extremely simple, and depends upon a principle of electricity which has long been known. The difficulty lies in the practical application of this principle.

Candles are made of different resistances, either by modifying their thickness, their length, or their composition; or, on the other hand, by fitting them with different primers.

The practical result thus obtained was far from satisfactory. Besides the confusion in the manufacture, and that resulting from the employment of several kinds of candles which had to receive special marks to distinguish them, a quite unexpected result was reached. The primers of all the candles were broken and crumbled away by the passage of the first electric current thrown into the circuit, so that many of the candles could not be lighted when it was their turn to burn. It happened also very frequently, and especially at the beginning of the lighting, that the one which was burning went out without known or apparent reason, whilst the next one became kindled instead; so that after three or four hours of service almost all the remaining candles were out of action.

It is plain that under these conditions the derivation-system became impracticable, and was abandoned by all who had tried it; the solution of the problem being considered impossible.

Without a knowledge of the experiments made in this direction, we had studied the question in our turn. We were led to this attempt by the desire of improving the 48 Jablochkoff burners used in the workshops of the La Buire timber yard at Lyons, where frequent extinctions had caused some annoyance.

After prolonged experiments, we ultimately attained the most satisfactory result that could have been hoped for: no primer was upset, not a candle went out; that is to say, with chandeliers of eight candles we lighted up our workshops for fourteen consecutive hours, without any superintendence, and with apparatus much more simple than heretofore.

This result is due to the complete investigation which we made into the primers of the candles, and the phenomena which determine their ignition.

In our numerous researches we found that:—

1. Of two primers of the same bulk the less resistant became ignited first.
2. Of two primers of the same resistance, the less bulky became ignited first.
3. A torrified or super-heated primer becomes enkindled much more easily than one untouched, *although its resistance has become infinitely superior* by the fact of the disaggregation of its particles.

The two first cases are quite natural and conformable to the principles of electric circulation.

The third case is less easily explained, and appears to contradict these principles. The following appears to us the most likely explanation. When a primer has been scorched or super-heated its particles scarcely touch each other. If the least spark occurs among these particles they redden and ignite with the greatest ease, their mass being very slight. Now we know that the electric current undergoes certain variations in its passage across the arc of the burning candle; a kind of momentary hesitation, during which a very small quantity of the primary current seeks to branch off into other candles. If during one of these derivations the current occasions the minutest spark in one of the candles whose primer has been scorched, this becomes ignited, and the former one goes out.

This is the great rock upon which the derivation-system of candles has hitherto been wrecked.

Two essential things have to be observed in this system:—

1. To use candles with high resistance primers.
2. To preserve these primers in their original state of resistance and consistence.

The primers which we employ have a mean resistance of about 50,000 ohms; but they vary among themselves by some hundreds or even thousands of ohms.

It seems almost incredible that a current of 7–8 ampères—that generally given by Gramme machines for alternating currents—should overcome resistances

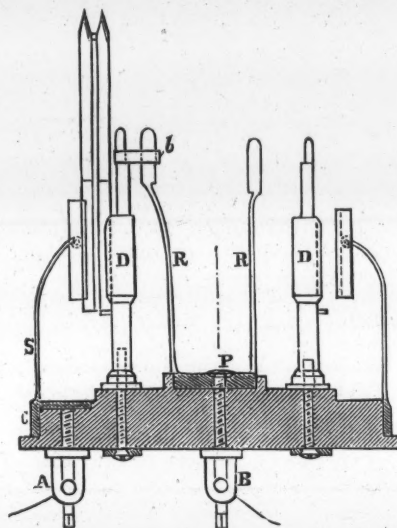


FIG. 1.—SECTION ON LINE A. B.

so considerable; but the fact is, nevertheless, established. The measurement of the resistance has been executed with the greatest care, and with different instruments, which enables us to speak very confidently as to their accuracy.

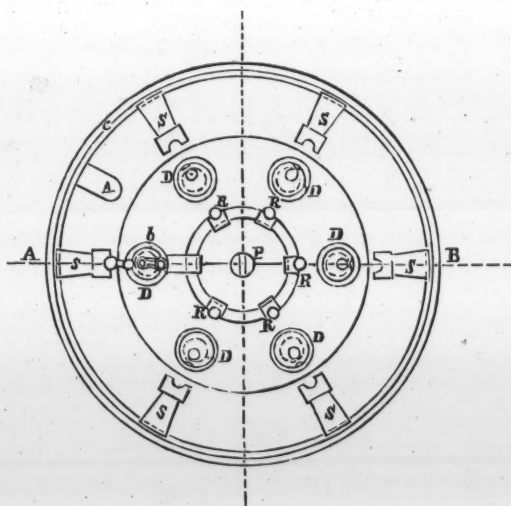


FIG. 2.—PLAN.

It is necessary that the resistances of the primers should differ considerably among themselves, and we obtain these different resistances with the greatest ease, or it may even be said involuntarily. The carbonaceous paste which serves for making the primers is never absolutely homogeneous. It will be easily seen that if this paste has a considerable resistance, say, of 50,000 ohms, it is materially impossible to obtain the primers alike, and, whether we wish it or not, they will always differ from each other by a great number of ohms.

This paste is formed of a very fine powder of fir-charcoal, of gum arabic and of a quantity of graphite varying with the resistance which it is intended to give to the primers.

Practice has convinced us that primers of about 50,000 ohms give the best results. We have, however, carried our experiments up to primers of 900,000 ohms which became ignited perfectly.

We have said above that one of the conditions essential to the economy of the system is the preservation of the original resistance and consistence of the primers. To this the candles must be at a distance from each other of not less than 40 millimetres at their summit; if this distance is less, the heat of the arc of the candle which is burning rapidly scorches the primer of the next candle, which then has a great tendency to become ignited in place of the former, as we have explained above.

I have not as yet spoken of the manner in which we effect the extinction of the candles which are on the point of being used up. The figs. 1 and 2 show the arrangements which we have adopted and which have never yet failed.

A is one of the two terminals; it is in communication with the circle, C, on which are fixed the external supports of the candles.

D, interior supports of the candles, insulated from each other.

B, the other terminal in communication with a central plate, P, upon which are fixed as many springs as there are candles.

b, a small rod of lead which effects a temporary communication between the springs, R, and the supports, D; this rod must be very near the candle.

The current will only pass through the candle which is burning as long as this leaden rod is in place.

When the candle burns near the rod it softens, the spring, D, is straightened out, removes it and thus the current is shut off from this candle and throws itself instantly upon the least resisting of those which remain.

When a candle goes out because it is defective or in consequence of any other accident, another instantly becomes ignited without any interruption being perceptible.

An accessory feature of our chandelier which is of serious importance as regards conflagrations and the preservation of the apparatus, consists in arranging the stands of these burners in steps, that is placing the inner and outer supports of the candles upon different horizontal levels. Thus we avoid, what frequently happens, that the fragments or the dust of the carbons falling upon these stands establish communications between the bases of the supports of the candles, which often occasions the destruction of the chandelier by causing a spark to spring over at such places.

In fine, the apparatus just described effects in the highest degree the three main conditions of all electric lighting—simplicity, safety, and economy.

NIAGARA FALLS AS A SOURCE OF ELECTRICAL ENERGY.

THE first suggestion of the possible employment of Niagara Falls as a source of electrical energy, and the distribution of this energy in the shape of light and power, writes Prof. John Trowbridge in a quite recent number of *Science*, is due to C. W. Siemens. It was a large suggestion; and it took root speedily in what may be termed "cosmical minds." The way, however, to its fulfilment, has not been made plain to business enterprise. The most noteworthy remarks upon this subject were made by Sir William Thomson in 1881, at the York meeting of the British Association. His remarks and calculations were in substance as follows:—With the idea of bring-

ing the energy of Niagara Falls to Montreal, Boston, New York, and Philadelphia, a total electromotive force produced by the dynamo machines at the Falls was taken at 80,000 volts. This was between a good earth connection at the Falls and one end of a solid copper wire of half an inch in diameter, and 300 statute miles in length. The resistance of the circuit was so arranged that there should be an electromotive force of 64,000 volts at the remote end, between the wire and the earth connection. The calculations showed that a current of 240 webers would be produced in the wire, which would take energy from the Niagara end at the rate of 26,250 horse-power, and only 5,250 horse-power would be lost by the generation and dissipation of heat through the conductors; and thus 21,000 horse-power would be available at the cities above mentioned. According to Sir William Thomson's calculation, it will be seen that 80 per cent. of the energy would be thus transmitted. He also supposed that the solid copper wire was supported, like the ordinary telegraph wire, upon poles, and found that an electric spark would not be produced between wires electrified to the difference of potential of 80,000 volts, unless they were within three-quarters of an inch apart: there could not be, therefore, great difficulty in the insulation. The cost of the copper conductor was reckoned at \$185,000; and the interest upon this at five per cent. is \$9,500 a year.

At the time these remarks were made great hopes had been excited by the invention of the Faure storage battery, and Sir William Thomson closed his address by a glowing picture of the possibility of keeping a Faure battery of 40,000 cells constantly charged, we will say in New York, and applying a methodical system of removing sets of 50, and placing them upon local supply circuits, while sets of 50 are replaced upon the main conductor.

The electromotive force of a Faure cell is in the neighbourhood of 2 volts, and 50 cells would give 100 volts, which would be sufficient to supply several arc lights. Thus the great electromotive force of 80,000 volts could be subdivided. Unfortunately, however, it has been found that the Faure battery is not permanent, or even fairly so. It can be said, without exaggeration, that its working-life is less than a year, and during the time of its best estate it cannot be depended upon. Many attempts have been made to perfect the Faure cell, and other forms of electrical accumulators; but no form of storage battery is a commercial success at this present writing. It is not, however, beyond the power of invention to devise a system of what are called step-down dynamo machines, by means of which the great difference of potential of 80,000 volts can be subdivided and utilised on different circuits. A number of small dynamo machines could be connected with the great copper conductor leading to Niagara Falls in such a manner that the energy transmitted by this conductor could be distributed over a large extent of territory, either in the shape of light or power.

The distribution of light from a great central station has already been accomplished. The system of village lighting devised by Edison can now be studied by those who are interested in the employment of the energy of Niagara Falls for a similar purpose. The limitations of distance apply to the present central electric lighting stations; and those who are sceptical in regard to the great plan of utilising Niagara Falls as a source of energy make a strong point when they ask why the system of great central stations has not been rapidly increased. It is true that abundance of water power takes the place of coal; but the cost of the long conductors, the maintenance of the insulation, and the interest on the cost of any method of subdivision, must also be considered, and may be found to offset the cheapness of the source of the energy. We imagine, moreover, that few towns or cities would be willing to depend for their light on a seat of energy so remote as even 50 miles, to say nothing of 300. An accident to the copper conductor, due to the falling of a tree, or to some mischievous action, could plunge a city into darkness. If the conductor were placed underground, de-

fective insulation would enter, and produce the same result. Even if the system of utilising Niagara Falls as a source of electrical energy should be adopted, a supplementary system of lighting would have to be maintained in every city.

It is not safe to assume that, if this large scheme of utilising Niagara Falls could be made successful, business enterprise would already have moved in this direction; for capital, it is well known, is extremely conservative. The true reason that large sources of water power have not been utilised for electric lighting on a large scale, is due to the fact that the small details, and what are called the small items, assume great proportions, and bid fair to consume all profits which come from a saving of coal. Thus the city of Buffalo could have been lighted by the utilisation of the water power along Niagara River; and we cannot believe that the failure to do so has been due either to the opposition of the gas companies, or to the lack of imagination of capitalists. In short, the facility with which energy in the shape of coal can be transported from place to place counterbalances at present the cheapness of a very remote source of energy in the shape of a waterfall.

The reasons for and against the utilisation of the energy of Niagara Falls as a source of light apply also to the question of the electrical transmission of power, with this exception, that the electrical transmission of power has not reached even the perfection which systems of electric lighting have attained.

SUBTERRANEAN WIRES IN PRACTICE.

THE following notes on the subject of underground and overground lines of telegraph located on road and railway for commercial working were appended to a recent report of the Massachusetts Railroad Commissioners, and were republished in the *New York Electrician and Electrical Engineer*.

The objections to having a number of independent telegraph lines established on a railroad location are: the amount of space taken up by the wires, the interference with the sight of signals and the liability of broken poles causing accidents to trains.

The proper distance from track at which telegraph poles should be placed for railway working is the line of the right of way. For independent working it is the line of the nearest road.

The limit of the extent to which wires can be laid underground is simply a question of insulation, *i.e.*, an insulation which will not retard working, and at the same time prevent interference. Underground wires should be so insulated that no moisture should penetrate the outside covering; it should be reasonably decay-proof, water-proof and fire-proof; it should not carbonise or corrode the conductors. The insulation should be low but the conductors well separated and kept clear from all atmospheric influences, as well as from the earth. Underground wires are largely used in other countries. London has nearly a complete system, and in Germany there are 221 cities connected together; 3,400 miles in all of underground, containing 23,000 miles of wires. The cost of the German system was \$2,639 per mile of 21 wires, placed in pipe and buried at a depth of four feet. This includes labour, material, &c., all ready for use.

Sectional boxes can be laid for \$2,000 per mile, sufficient to accommodate several hundred wires.

Brooks's cable system laid through pipe filled with oil, containing from three to four hundred wires, can be placed at a cost not exceeding \$20 per line per mile ready for operation.

The objections to the underground are: the liability of causing retardation, causing slow transmission of messages, and the trouble and expense in making repairs.

An eminent English authority on the subject of telegraph lines notes: Where there is a choice between an

overground and underground system there should be no hesitancy in selecting the former, for not only is the first cost less, but faults occurring upon them can be more readily traced and rectified; but that where there is a choice of location for an overground independent line of telegraph between a road and railway, they both offer advantages and it is no easy matter to say which is to be preferred.

The first cost of a line located on a road is greater than upon a railway, but yet its subsequent maintenance under certain conditions is less; the supervision of it is more perfect, for the fact that the poles are erected along the side induces better inspection, and little imperfections are thus easily detected.

On a railway location walking is difficult and consequently too often neglected, the lineman contenting himself with travelling by train, from which close inspection is next to impossible.

The reparation of faults is, as a general rule, more speedily carried out upon roads than upon railways. In case of the former, the lineman can start immediately the fault is reported to him; with the latter he has not only too often to wait some time for the starting of a train, but frequently is carried past the fault and has to return to it many miles on foot.

For an underground system carrying wires between cities, *i.e.*, outside of street limits, following a railroad or turnpike, a conduit alone can be laid for \$1,580 per mile, capable of holding 50 wires. The wires with good insulation will cost \$105 a mile each, if separate; if by cable carrying 10 or 15 wires each, the cost would not exceed \$85 per mile for each conductor.

Taking this as a basis, a system with provision for carrying 50 wires, with 15 laid in place, would cost, all complete, \$2,855 per mile.

In cities, within street limits, the cost of labour to be added to the above depends on the location with respect to pavement or street, but in any case would not add more than \$500 per mile to the above. Cross lines leading to houses are not included.

REPORT FROM MR. HAMILTON

As to the Western Union underground wires in New York city (there being practically no other underground system), from general office to Pier 18, two parallel pipes of 2,031.50 feet.

4,063 ft. iron pipe, at 20 c. per ft.	...	...	...	\$812 60
Coating 130 pipes, 1,251 ft., at 3 cents	...	...	...	37 53
Carting	...	...	...	8 00
Laying (two 1,850 ft. parallel) 3,700 ft. of pipe, two pipes in trench, at 22½ c.	...	...	...	832 50
Setting and cutting 4 flush boxes (test boxes)	...	...	...	72 00
Laying and furnishing stone for 60 yards Belgian pavement, at \$2.25	...	...	...	135 00
Elbows, iron work, &c., at cable house (Pier 18)	...	...	...	50 85
Extra labour, &c., at and around Pier 18	...	...	...	60 50
Cable house at Pier 18, N. E., invoice by G. M. P.	...	...	...	160 25
				\$2,169 23
Two cables of 2,130 ft. each, or 4,260 ft. (30 conductor cable)	...	...	...	\$3,424 15
Labour of drawing in	...	...	...	40 91
				\$5,634 29

In the latter part of 1876 or early in 1877, two 30 conductor cables (about 2,200 feet each) were laid from the General Office, 195, Broadway to Pier 18, North River.

Eight or mere conductors in one of these cables failed before the end of 1880. These were repaired about October, 1881, by drawing in a new piece in place of the defective portion.

Seventeen conductors in the other cable failed in November, 1880, by breakage of iron conduit under the dock. Overhead wires were substituted until April, 1881, when this cable was replaced by a new one containing 60 conductors.

At the present time three conductors are interrupted, 57 good.

The remaining 30 conductor cable was extended to Pier 16, in February, 1882. It was afterwards replaced by another of 60 conductors.

At one time 20 conductors by this route were interrupted by the heat from the Steam Heating Com-

pany's pipes, but I am unable now to say whether it was the 30 conductor before its replacement, or the 60 conductor cable.

At the present time four conductors are interrupted, 56 good.

A 12 conductor cable, 2,200 feet long, was laid between the office, 195, Broadway, and 14, Broad Street, in October, 1876; cable destroyed in October, 1883, by steam pipes. Has not been replaced.

A 28 conductor cable, 2,050 feet long, was laid May, 1880, between 195, Broadway and 8, Broad Street; 11 conductors failed November, 1882. Cause, steam pipes. Eight conductors working now.

A 30 conductor cable, 500 feet long, was laid between 134, Pearl Street and the Cotton Exchange, in May, 1882. At present time two conductors are defective, 28 good.

A 60 conductor cable, 2,778 feet long, was laid between 195, Broadway and 134, Pearl Street, in May, 1882. Failed November, 1882. Cause, steam heating. Cable has been abandoned.

A 30 conductor cable, 730 feet long, was laid in Jersey City, December, 1876. Failed October, 1882. Cause, exhaust steam pipe passed underground near cable, melted gutta-percha.

Repaired soon after, and an additional cable put down. All conductors perfect at present time.

A 30 conductor Brooks cable was laid between Newark and Jersey City suburbs in 1880. The wires failed rapidly when put in service. This cable was afterwards repaired, part of the route changed, and considerable new cable added or substituted for defective portions in 1882. It saw scarcely a year's service, however, and none of the conductors are now in use. The experiments with this cable were made at an expense of more than \$20,000.

GEO. A. HAMILTON, *Electrician*.

THE SAWYER-MAN INCANDESCENT LAMP PATENT.

IN order, as it would seem, to still further complicate matters in regard to the coming litigation in the States respecting incandescence lamp patents, the Patent Office has just issued to the Consolidated Electric Light Company, assignee of Sawyer and Man, a patent by which the Company claims to have established priority of invention of the incandescence lamp. Mr. Edison filed his original patent on high resistance carbons on November 4th, 1879, and his patent was issued on January 27th, 1880. But in the meantime Sawyer and Man had filed their application on January 9th, 1880; and when it came to be acted upon an interference with the Edison patent was declared. Messrs. Sawyer and Man claimed priority of invention, and the case was carried from the Examiner-in-Chief to the Commissioner of Patents, and finally to the Secretary of the Interior. This patent office litigation was decided in favour of Sawyer and Man, and hence the allowance of the patent after more than five years.

Readers will find in the ELECTRICAL REVIEW for January 1st, 1879, a description and illustration of the earlier form of Sawyer-Man lamp, in which an upright carbon pencil impinging against a curved electrode and actuated by a spring as it was consumed by the heat was the incandescent illuminating agent.*

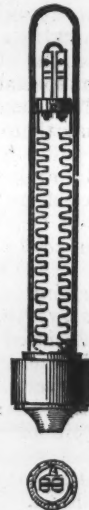
For the following particulars relating to the Sawyer and Man patent we are indebted to our namesake of New York:—

There was granted, May 12th, 1885, to Wm. E. Sawyer, of New York, and Albon Man, of Brooklyn, patent No. 317,676, on electric light, application for which was filed January 9th, 1880. This invention relates to that class of electric lamps employing an incandescent conductor enclosed in a transparent hermetically sealed vessel or chamber, from which oxygen is excluded, constituting an improvement upon a patent granted to the same parties June 18, 1878, No. 205,144.

* The Werdermann lamp, it may be remembered, was upon very much the same principle.

It relates especially to the incandescing conductor, its substance, its form, and its combination with the other elements of the lamp. The improvement consists, first, of the combination in a lamp chamber composed wholly of glass (as described in patent No. 205,144) of an incandescing conductor of carbon made from a vegetable fibrous material, in contradistinction to a similar conductor made from mineral or gas carbon, and also in the form of such conductor so made from such vegetable carbon, and combined in the lighting circuit within the exhausted chamber of the lamp. The illustration gives a top view and a side elevation of the lamp. There is a glass flange on the bottom of the lamp chamber, and a glass disc corresponding to the flange is ground to the bottom thereof to form an air-tight joint, so that the entire wall of the chamber is formed of glass, the electrodes passing through the glass disc. The sealing of the electrodes, where they pass through the glass wall, is done with any suitable cement, or any of the known methods of sealing glass upon metal electrodes. The inventors state that they made use of carbonised paper and also wood carbon, and have used conductors of various shapes, but prefer the arch as it permits the carbon to expand and contract under the varying temperatures to which it is subjected without altering its fixed terminals. The inventors conclude their specifications and claims as follows:—

"The advantages resulting from the manufacture of the carbon from vegetable fibrous or textile material instead of mineral or gas carbon are many. Among them may be mentioned the convenience afforded for



cutting and making the conductor in the desired form and size, the purity and equality of the carbon obtained, its susceptibility to tempering, both as to hardness and resistance, and its toughness and durability. We have used such burners in closed or hermetically sealed transparent chambers, in a vacuum, in nitrogen gas, and in hydrogen gas; but we have obtained the best results in a vacuum, or an attenuated atmosphere of nitrogen gas, the great desideratum being to exclude oxygen or other gases capable of combining with carbon at high temperatures from the incandescing chamber, as is well understood.

"We claim as our joint invention:—

"1. An incandescing conductor for an electric lamp, of carbonised fibrous or textile material and of an arch, or horse-shoe shape, substantially as hereinbefore set forth.

"2. The combination, substantially as hereinbefore set forth, of an electric circuit and an incandescing conductor of carbonised fibrous material, included in and forming part of said circuit, and a transparent hermetically sealed chamber in which the conductor is inclosed.

"3. The incandescing conductor for an electric lamp, formed of carbonised paper, substantially as described.

"4. An incandescing electric lamp consisting of the following elements in combination: First, an illuminating chamber made wholly of glass hermetically sealed, and out of which all carbon-consuming gas has been exhausted or driven; second, an electric circuit conductor passing through the glass wall of said chamber and hermetically sealed therein, as described; third, an illuminating conductor in said circuit, and forming part thereof within said chamber, consisting of carbon made from a fibrous or textile material, having the form of an arch or loop, substantially as described, for the purpose specified.

"In testimony whereof we have hereunto subscribed our names this 8th of January, 1880."

We have given at some length the details of the above patent, because of the interest it will attract in the electric light field. As is shown in the decision of the Commissioner of Patents, the patent has been issued after having been before the Patent Office for over five years, during all of which time the question was being examined as to whether Edison or Sawyer and Man were prior inventors. The best legal talent was employed on both sides, bushels of testimony submitted, and the case closed and reopened on one or two occasions, in all comprising a litigation that made attorneys robust and happy, and stockholders of electric light companies weary and heart sore. At one time during the examination all the claims of Sawyer and Man had a black mark drawn across them, the specifications and testimony not being strong enough to satisfy the examiners. The third claim of Sawyer and Man, for the use of carbonised paper as a filament, was the one on which the interference with the Edison invention was declared, and this proved the apparent bone of contention, yet not one of the companies to-day look upon this claim as of special importance, and probably not one is using the carbonised paper. But each inventor soon realised that there was something more valuable than this one point at stake, and made the fight accordingly. The Commissioner decided that the testimony and office record proved that Edison had perfected his invention in October, 1879, and applied for patent December 11th, 1879; that Sawyer and Man had their invention in a crude form in March, 1878, and had it practically working in September, 1878, and applied for patent January 9th, 1880, and therefore Sawyer and Man were declared the inventors on the grounds of priority, and patent issued to them. The testimony showed that Sawyer and Man did not realise the importance of their invention, and did not use that dispatch in securing their patent that they would otherwise have done.

The case was re-opened in one instance, to show that Sawyer had in a book of his, and by various newspaper articles, discarded as of no value the very thing that proved to be the chief corner stone, but it was decided that his action could not invalidate the claim of the joint inventors, it having been satisfactorily proven that Sawyer and Man were joint inventors. This decision has newly vitalised the company owning and controlling the Sawyer and Man patents, and their policy, which will no doubt be an aggressive one, will soon be outlined.

THE INCANDESCENT LIGHTING PATENT SUITS IN AMERICA.

As announced in our last issue, the Edison Electric Lighting Company of New York has instituted suits against a large number of the users of the incandescent light in America, as well as the manufacturers and sellers. Principal among the defendants are those who have made and used the Weston system, against whom alone nearly 40 suits have been brought. Among the others are the Consolidated Electric Light Company, using the Sawyer-Man system; the Brush-Swan Company, using the Swan lamp, and the Schuyler Electric Light Company.

On the other hand, the Edison Company has been sued by the United States Electric Lighting Company for infringement of a

number of its patents (which are given below) granted to Edward Weston, Moses G. Farmer and Hiram S. Maxim. For the following *resumé* of the points at issue we are indebted to the New York *Electrical World*.

As the substance of the suits brought by the Edison Company against all the parties is nearly identical, a statement of the complaint against one of them will be sufficient to show the points at issue.

Thus, the United States Electric Lighting Company has been proceeded against on the alleged infringement of fifteen patents, fourteen of which have been issued to T. A. Edison and one to Wm. Holtzer.

The first of these in point of date, and it may be said, in importance also, is that of Jan. 27, 1880, No. 223,898. Our illustration, fig. 1, shows the manner in which the lamp was represented in the patent drawing. The claims are four in number, the last two of which may have no commercial value to-day. The first two, however, are of eminent importance, and are as follows:—

1. An electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance, made as described, and secured to metallic wires.

2. The combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air is exhausted.

The second patent in dispute, No. 227,229, dated May 4, 1880, relates to a lamp, the incandescent film of which was of platinum, which was gradually heated to expel the air without disintegrating the metal. This lamp has an outer glass casing, and is provided with a thermal regulator, operated by the expansion of the air between the lamp and vacuum case. The essential claims in this patent are the following:—

1. In an electric lamp, the combination, with a hermetically sealed vacuum chamber made entirely of glass, of metallic conductors passing through the glass and around which the glass is melted, and an incandescent conductor placed in the electric circuit.

2. The method herein specified of treating metallic conductors for electric lamps, consisting in inclosing the conductor in a glass case, exhausting the atmosphere from such case, heating the conductor by an electric current, and then hermetically sealing such glass case.

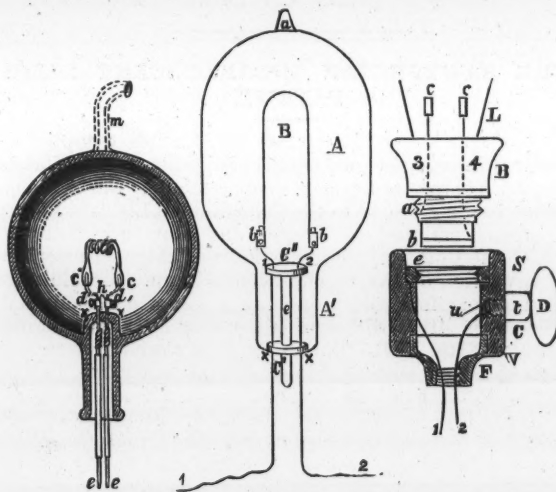


FIG. 1.

FIG. 2.

FIG. 3.

The next patent in the order of issue is that of July 20, 1880, No. 230,255, which relates to the method of manufacturing electric lamps. The claims contained in this patent describe the process sufficiently, and read as follows:—

1. The method of forming electric lamps, consisting in separately forming the inclosing globe and the supporting bulb for the incandescent conductor, attaching the wires and incandescent conductor thereto, and then hermetically uniting the parts prior to the formation of the vacuum.

2. The method of hermetically sealing a vacuum chamber, which consists in first sealing *in vacuo* and then sealing in air.

The next patent describes an incandescent lamp in which the bulb supporting the filament is made with a depression at the top, so that the atmospheric pressure is exerted on a convex surface. The patent, which is numbered 239,149, and dated March 22, 1881, has two claims, and they are:

1. An incandescing electric lamp, the supporting neck formed with a concavity at the point where the leading wires pass through and are sealed therein.

3. The supporting neck formed with a solid glass projection, to and upon which the inclosing globe is supported and sealed.

Six additional patents embracing methods of manufacture of lamps or filaments are included in the following order:—

No. 239,153, March 22, 1881, relates to the mounting of the filament upon a support sealed to the globe, as shown in fig. 2.

No. 248,418, Oct. 18, 1881, is a patent describing a form of filament of a continually diminishing cross-section or taper from the negative toward the positive pole. One of the claims is as follows:—

"A carbon for an incandescing conductor for an electric lamp, having one of its ends or portions of less resistance and greater mass of matter than the other."

No. 266,447, Oct. 24, 1882, is a method of manufacturing incandescent lamps, which is described in the claims as follows:—

"The method of manufacturing incandescent electric lamps, consisting in forming the inclosing bulb or globe directly from molten or pot glass, forming separately the supporting tube or neck for the incandescent conductor, sealing therein the leading-in wires, attaching the carbon thereto, and then hermetically uniting the parts by a welding together prior to the exhaustion of the lamp."

"A leading-in wire composed of a central platinum section for sealing into the glass an outer section and an inner section, having a clamping device formed integral therewith."

No. 265,777, Oct. 10, 1882, is a patent on a method of treating carbons. The principal claim reads:—

"The method of treating the carbon filament of an incandescing electric lamp, consisting in raising such carbon filament to a higher incandescence than that at which it is designed to be used during the latter part of the process of exhausting the lamp-globe, whereby the air and gas are driven from the carbon filament and from its enlarged ends and clamps, and the flexibility of such filament is increased and its shape fixed."

No. 307,029, Oct. 21, 1884, according to the claim, is a "process of forming the flexible incandescing filaments of electric lamps, consisting in first forming a straight filament of carbonisable substance, then carbonising the same, and finally bending the flexible filament thus formed into the desired shape."

Besides the patents on lamps, there are several relating to fixtures, lamp sockets and dynamo-machines, as given below.

No. 248,424, Oct. 18, 1881, relates to the employment of a "safety-catch" in the lamp circuit, and to the pendent lamp and reflector, as shown in the following claims taken from among five:—

"The combination of a base-piece such as described, a lamp or chandelier standard, a safety-catch and a cap covering the base-piece."

"The combination of a pendent incandescing electric lamp and a socket to which said lamp is removably attached, with an open flaring reflector supported by means attached to or above said socket, whereby the downward reflection of the light is uninterrupted and the lamp can be removed from and placed in said socket without disturbing the position of said shade or reflector."

No. 251,554, Dec. 27, 1881, the patent illustrated in fig. 3, relates to the lamp-holder or socket, and is described by the following claim:—

"The combination, with an incandescent electric lamp and its socket, detachable from each other and adapted to be used in a complete or round wire circuit, of controllable means for positively holding them in position together, and means for automatically completing the circuit connections between them through both limbs or members of the circuit upon placing them together in position."

The other claims of the patent are upon a device for a switch or circuit breaker.

No. 263,140, Aug. 22, 1882, the patent of T. A. Edison, relates to the brush holders of the dynamo, and the principal claim is as follows:—

"In a dynamo or magneto-electric machine, the combination, with the commutator, of two series of brushes (one upon each side), each brush of a series being mounted independently upon a supporting shaft or bar common to all of its series, and provided with means within itself for adjustment of pressure independently of all the others of the series."

No. 265,311, Oct. 3, 1882, describes an electric lamp and holder for the same, adapted to be placed on a gas bracket, and of the six claims we give the two following:—

"A separate electric lamp, consisting essentially of an inclosing globe entirely of glass, an incandescing material secured therein, conductors leading thereto and sealed in the glass where they pass there-through, and a base of insulating material in which the neck of the globe is secured, said base being provided with metallic contact-plates to which the conductors leading into the globe are secured at their outer ends."

"A socket for an electric lamp, adapted to be placed upon a gas-pipe or other suitable support, and provided with contact-plates forming the terminals of an electric circuit."

No. 288,318, Nov. 13, 1883, embraces the regulation of dynamos by means of varying external resistance in circuit with the field coils. Of the seven claims two are as follows:—

"The combination, with an electrical generator, of an adjustable resistance in addition and external to the field-magnet coils, and located directly in the field-circuit of the generator, for primarily and directly regulating and varying the strength of the field-magnet below the point of saturation."

"The combination, with a battery of generators and a separate generator supplying the field-current thereof, of means acting on the separate generator to regulate its production of current and thereby regulate the generative capacity of the entire battery."

There remains still another patent granted to Wm. Holtzer and owned by the Edison Electric Light Company, upon which suit has been brought. This is numbered 264,498, Sept. 19, 1882, and relates to the manufacture of the electric lamp. The process

consists in passing the leading wires into a tube, heating the end of the latter and then clamping the molten glass together so as to inclose the wires hermetically. This forms the base which is fused into the bulb and upon which the filament is mounted.

This, briefly stated, constitutes the ground upon which the suits have been brought by the Edison Company, but, as stated before, it has also been served with the papers in a counter suit for infringement, by the United States Electric Lighting Company. The latter's bill of complaint sets forth that seven of its patents have been appropriated by the other company. These patents were granted to H. S. Maxim, M. G. Farmer and Edward Weston, and are as follows:—

No. 244,277. H. S. Maxim, July 12, 1881. Incandescent electric lamp. This patent relates to the method of leading in the platinum wires so as to leave a perfect seal. Where a large conductor is used, Maxim divides it into a number of smaller which will make good joints, as shown in fig. 4. The claim reads as follows:—

"In an electric lamp, a continuous incandescent conductor inclosed in a transparent vacuum globe, in combination with conducting wires leading to said conductor, each of which is divided where it passes into the globe into two or more branches, to which the material of the globe is directly sealed by fusion."

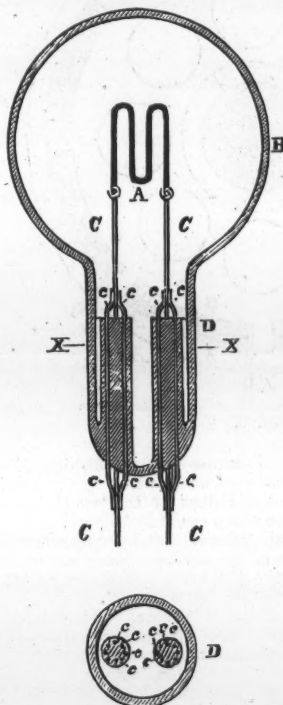


FIG. 4.



Fig. 5.

No. 252,836. M. G. Farmer, Jan. 24, 1882. Electric lighting system. This is a method of controlling and regulating the current in an incandescent system, and three of the claims are as follows:—

"In an incandescent electric lighting system, the method of uninterruptedly controlling the strength of current of a main line of continuous conductors by and correlatively with incidental variations of strength in the same current traversing a continuous branch circuit."

"In an incandescent electric lighting system, the method of varying the strength of current of a main line of continuous conductors by dynamic effects produced by variations of strength in the same current traversing a continuous branch circuit."

"The combination of a generator of electricity, two or more separate branches or derived circuits connecting the poles or main conductors of said generator, one or more electric lamps included in each of said branches, an adjustable rheostat included in that portion of the circuit of the generator common to all the lamps and mechanism, whereby the resistance of said rheostat is diminished as the joint resistance of the whole number of lamps is increased, and the reverse."

No. 253,817. Feb. 14, 1882. M. G. Farmer, Electric light apparatus. This is an apparatus embodying the above principle, and constitutes an automatic regulator. One claim reads as follows:—

"The combination of a rheostat, mechanism for increasing or decreasing the resistance of said rheostat, an electro-magnet included in the same electric circuit with the rheostat, or in a branch thereof, and a lever for controlling the action of said mechanism, which is normally balanced between the attractive force of said electro-magnet and a constant antagonistic force, and contact-stops for limiting the motion of and determining the action of said lever."

No. 254,032. Feb. 21, 1882. H. S. Maxim. Electric lamp. This patent relates to the manufacture of the carbon filament. The claim covers the method of gradually decreasing the section of the filament from the point of attachment to the leading-in wires to the point where incandescence begins. The object is to prevent breaking of filaments by a sudden break in continuity.

No. 259,614. June 13, 1882. Edward Weston. Safety device for electric circuits. This is shown in fig. 5 and is the "safety catch" composed of fusible alloy. Two claims read as follows:

"The combination, with a circuit or branch thereof, of a safety device which fuses at a temperature below the ignition-point of wood, paper, fabrics, or other like combustibles.

"The combination, with an electrical conductor, of a strip or wire of higher resistance than the said conductor, and which fuses at a temperature lower than the ignition-point of wood, paper, fabrics, or other like combustibles."

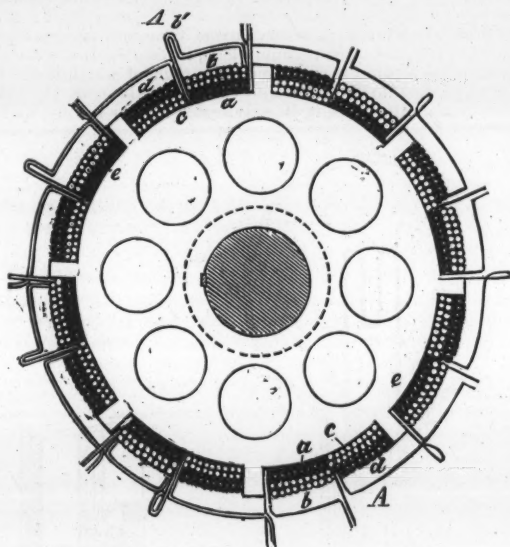


FIG. 6.

No. 259,618. June 13, 1882. Dynamo-electric machine. This is the method of winding the armature, as shown in fig. 6. It consists in superposing the several divisions of the two systems of coils in the manner shown. The claim reads as follows:

"An armature wound with two systems of coils in diametrically separate divisions, the divisions of one system being alternately under and over those of the other, and the said divisions being looped together and connected to the commutator."

No. 277,644. May 15, 1883. Edward Weston. This patent relates to means for obviating the use of single heavy conductors for winding the armatures of dynamos of powerful current.

The invention consists in the combination, with a cylindrical core, of conductors formed of separate strands of wire or thin strips, which may be more readily bent than solid wires or bars, and which may be spread out over the ends of the core, so as to add but little to the total length of the armature. Two of the claims read as follows:

"The combination, with an armature core, of a system of conductors composed of massed strands or strips of conducting material.

"The combination, with a cylindrical armature core of a system of conductors wound thereon, and composed of groups or bundles of fine wire, each group being spread out at the ends of the core."

These suits have been brought in the U. S. Circuit Court for the Southern District of New York, and will probably not be called for several months.

CHEAP TELEGRAPHY AND CODIFICATION.

DR. CAMERON, M.P. for Glasgow, propounds a scheme in a letter to the *Times* for a satisfactory application of the sixpenny telegram principle, which is singular in its simplicity, combining all the essentials of cheapness and adaptability with that economy in transmission which is so much desired on the part of the Postmaster-General. Dr. Cameron says:—

"In the course of the debate on the Telegraph Acts Amendment Bill last week I ventured to make a suggestion which, if adopted, would go far to reconcile the views of those who think that cheap telegrams without free addresses are not worth having, and of the Postal authorities, who assert that a system by which addresses would be really free (that is, not practically given at the expense of words in the body of the message) could only be worked at a loss, which they and the Treasury refuse to incur.

"If the proposal of the Postmaster-General be adopted as it stands, numbers consisting of several figures, and sometimes a

letter besides (*e.g.*, 120a), will be reckoned as one word in the address, while in the body of the message each respective figure or letter will be counted, as at present, a separate word. To complete the anomaly, in international European telegrams 'every group of five letters or figures is counted as a word, larger groups being counted at the rate of five for a word, *plus* one word for every excess.' ('Postal Guide,' p. 267.)

" Now, one object Mr. Fawcett had in view in proposing his uniform word-rate was to assimilate the principle of charges for inland telegrams to that prevailing in the international telegraph service of the Post Office. To do so the same mode of charging for groups, either of figures or letters, whether in the address or the body of a message, ought to be adopted in the two cases. If this were done we should have a simple, equitable, and intelligible system of charge in no way conflicting with the sound principle of a word-rate and of payment for work done.

"Assuming that to be conceded, let us see how the concession could be made use of for the purpose of securing the greatest possible advantage to the public with the *minimum* of work, and consequently expense, to the Post Office.

“The ‘Postal Guide’ contains a list of, roundly speaking, 5,000 streets, squares, terraces, crescents, courts, lanes, &c., in the metropolitan district. In this list in innumerable cases the same names recur repeatedly, and to distinguish a particular street or court it is necessary to add the name of a district, and often of some other street or square as well. Thus, there are five Prince’s Roads and 10 Prince’s Squares, which it is necessary to distinguish by their respective locations, and in many cases, to add to the verbosity of the address, the names are compound, as Great Chapel Street and Great College Street, of each of which there are two examples in the Post Office list, and Great James Street, of which there are three. In such cases a large proportion of the 12 words proposed to be allowed in a sixpenny telegram would necessarily be swallowed up in the address, and if the sender does not happen to know of the existence of more than one street of the same name in the same district, by omitting the distinctive description he inflicts unnecessary trouble on the Post Office, and probably his telegram miscarries.

"Now, we have already alphabetical printed lists of all the streets in London and in every large town in the United Kingdom, and it is necessary that telegraph clerks should constantly consult these lists in order to see to what district office each message should be sent for delivery. If opposite each name on the list were printed consecutive numbers, commencing with Abbey Gardens, St. John's Wood, N.W., as No. 1, and finishing with Young Street, Kensington, W., as No. 6,000, or whatever it may be, by sending four figures in each case, the name of the street, court, or lane could be accurately telegraphed, and that—under a rule already adopted by the Post Office in the case of international telegrams—as one single word. If this were done the most complicated address in London could be telegraphed with perfect security against mistakes in three words—one for the number, the second for the street, and the third for the town.

“ But the principle is susceptible of a wider application than this, for if it is easy to number the streets, &c., in London, it would be just as easy to arrange all the towns of the United Kingdom alphabetically, and under each town to give an alphabetical list of every street, &c. contained in it. The whole would thus be arranged on the familiar lines of a dictionary, and each street, square, and lane in the lot would have appended to it a distinctive number. This would require us to go into five figures—still one word—but with five figures we could deal with 99,999 different streets, and that is vastly more than are to be found in the entire United Kingdom. If such a code were prepared for telegraphic purposes it would probably not contain more than 50,000 names. It need not be more bulky than the present ‘Postal Guide,’ and by its use two words would suffice for the most complicated address in the United Kingdom, one for the number of the house and the other for the particular street and the town in which it was situated. The system would be so simple that the most stupid member of the public, and the most unintelligent post office clerk, could apply it. And it would apply with equal ease to the reception and the delivery of the message. All that would be required in either case would be to look out a street in its alphabetical place and note the corresponding figure on the one hand, or to run the eye over a consecutive series of figures on the other and note the accompanying name.

"An additional advantage of this system would be that it would enable the sender of the message, if he chose, to telegraph his own address, as is customary at present, at the cost of two words.

"In what I have written I have, in order to make my remarks more intelligible, spoken of numeral figures, but if instead of using these the letters of the alphabet were employed, the work of transmission would be still further curtailed. Close on 20,000 street addresses could be telegraphed by combinations of three letters, and the remainder by the use of four, so that the average work thrown upon the Post Office would be less than three and two-third letters for each address. The process of looking up the code or dictionary would be as easy in the one case as in the other, and if in compiling the list the code number of the office of delivery was prefixed to each street the work of the receiving clerk, who has to look up his code-book for the receiving office as it is, would not be appreciably increased even if the work of translating the address into its code letters were thrown upon him.

"To the Post Office the adoption of this proposal would afford a means of choking off everything that was superfluous in addresses while retaining everything necessary. It would get rid

of all difficulties arising out of insufficient address, and it would secure payment for work done on a scale per letter considerably higher than that at present charged.

"To the public it would afford the advantage that if Jones telegraphed to Smith, 130, Tottenham Place, Tottenham Court Road, W., he might send Smith's address fully and still have eight words in his message for 6d., while if he desired to let his friend know that his (Jones's) own address was 104, Crown Point Road, off Thomson's Lane, Mile End, Glasgow (an actual street address which I copy from the 'Glasgow Post Office Directory'), he would be able to give him the information and still have six words left out of his sixpennyworth.

"As to the application of the system, the work of turning up the directory and noting the code address—that, under proper arrangements, might be done by the receiving clerk without any appreciable addition to his present work. But if the Post Office authorities objected to have even this trifling additional labour thrown upon them, it might be equally well done by every sender who had learned how to look up a word in a dictionary, while to meet the case of hopelessly stupid or lazy senders, receiving clerks might be authorised to make a trifling extra charge of say 1d. or 1d. per message for inserting the code addresses whenever the sender requested them to undertake the task. Finally, persons prejudiced against codification altogether could telegraph their addresses as at present, paying, as they would have done if codification had never been thought of, at the proposed rate of a half-penny per word."

TECHNOLOGICAL EXAMINATIONS.

WE have been favoured with copies of the questions prepared for the technological examinations in connection with the City and Guilds of London Institute for the present year. These will be found below, and although we think that generally speaking they are more to the point than they have been hitherto, we may possibly at some future date have some comments to make thereon.

The Examiner is Prof. W. E. Ayerton, F.R.S.

22B.—Electric Lighting and Transmission of Power.

ORDINARY GRADE.

[Candidates are not to answer more than two out of the first three questions, and not more than seven questions altogether.]

1. Explain *exactly* what is meant by saying the electric resistance of a given wire is constant for the same temperature, and independent of the current passing through the wire.
2. A battery is sending a current through a wire. If this wire be gradually made shorter and shorter, describe what changes will take place (1) in the current, (2) in the potential difference at the terminals of the battery, and (3) in its electromotive force.
3. Define *fully* an ampere, an ohm, and a volt. What current will 15 cells, each having an E.M.F. of 1.07 volts and an internal resistance of 0.7 ohms, send through an electro-magnet having 28 ohms resistance, when the electro-magnet is shunted with a wire having 7 ohms resistance?
4. Why is it necessarily more costly to produce a given amount of light with incandescent lamps, as at present made, than with arc lamps?
5. Describe, with detailed sketches, some form of arc lamp with apparatus for automatically maintaining a fixed length of the arc.
6. What is meant by a compound wound dynamo? Describe, with detailed sketches, some form of compound wound dynamo.
7. Describe, with sketches, some form of commercial instrument for measuring strong currents, and mention what conditions ought to be fulfilled by such an instrument.
8. Edison glow lamps requiring 108 volts potential difference, and 0.72 of an ampere each, are required to be fed by accumulators, each having 2.1 volts E.M.F., and 0.0017 ohms resistance. What is the least number of such accumulators arranged in series that must be employed to feed 200 of these lamps in parallel?
9. Explain, with sketches, the instruments as well as their arrangements that you would employ to measure the "efficiency" of an arc lamp. Give examples of the sort of result you would expect to obtain.
10. Why cannot the direction of rotation of an electric motor be reversed by reversing the direction of the current passing through it? Describe, in detail, the methods by means of which the direction of rotation may be reversed.
11. Why are low resistance galvanometers used to measure large currents, whereas high resistance galvanometers are employed to measure large differences of potential? If a high resistance galvanometer arranged to measure the difference of potential between two points A and B in an electric circuit were replaced with a low resistance galvanometer, but without any other change being made in the arrangement, what would now be measured by this low resistance galvanometer?
12. What is meant by the "lead" in the brushes of a dynamo? Explain *fully* why sparking at the brushes occurs if the lead is wrong.
13. The potential difference at the terminals of a series dynamo running at a constant speed, first increases, and then diminishes,

if the external resistance be first large and then be steadily diminished. Give an explanation of this, graphically if you can, employing the characteristic curve of the dynamo.

14. Describe, by means of detailed sketches, the mode of constructing and connecting up (1) a separately excited, (2) a series, (3) a shunt dynamo.

15. What is a "watt?" Give a drawing and description of a wattmeter.

HONOURS GRADE.*

[Candidates are not to answer more than one out of the first three questions, and not more than seven altogether.]

4. Describe, with sketches, the mode of constructing and connecting up the wires in an alternate current motor.
5. How should two alternate current generators be coupled up so that the currents produced by the two generators may assist one another? Explain fully why the method you describe fulfils its object.
6. What sort of error would be produced by using a high resistance galvanometer to measure an alternating difference of potential? In what way can an alternating potential difference be measured accurately?
7. It is found that with a magneto-electric machine the E.M.F. is not absolutely constant for a given speed, but varies with the current produced. Why is this, and how can this variation of E.M.F. be reduced to a minimum?
8. What are the advantages and disadvantages of using secondary batteries? Show how a secondary battery should be attached to an electric light circuit fed with a shunt dynamo in order to steady the light.
9. In the last question calculate what may be the greatest resistance of a secondary battery compared with the resistance of the other portions of the circuit so that the potential difference at the terminals of the lamp circuit shall not vary by more than 1 per cent. when the E.M.F. of the dynamo increases by 8 per cent.
10. Judging from the experiments and calculations that have been hitherto made, in what cases would you recommend the employment of water transmission, and in what cases electric transmission, of power?
11. What are the exact experiments that should be made with an incandescent lamp in order to determine its commercial value relatively to that of other incandescent lamps?
12. You are required to design and fit an electro-motor to a tramcar. Describe the advantages and disadvantages of the following three methods (1) a rapidly-turning motor attached to the ordinary tramcar wheels with some speed-reducing gear, (2) a rapidly-turning motor attached to a small driving wheel running on the rail without speed-reducing gear, (3) a motor attached directly to the ordinary tramcar wheels, and only turning as fast as they ordinarily do. Select the one of the methods that you consider the best, and give sketches of the exact way in which you would carry it out.
13. Give detailed drawings of a non-sparking key.
14. Draw a curve connecting potential difference at the terminals of a shunt dynamo with the current flowing in the external circuit, and show how you can graphically construct from this a curve connecting the total electromotive force in the dynamo with the total current flowing through the armature.
15. What are the advantages and what the disadvantages of feeding the incandescent lamps in a district in series?
16. Show why the Board of Trade regulation requiring electric light to be supplied to a house within a given distance of the mains, and which must be charged for a fixed rate per Board of Trade unit, and, independently of the time per night that the current is required, cannot work fairly both in the interests of the supplier and consumer.

22C.—Electrical Instrument Making.

ORDINARY GRADE.

[Candidates are not to answer more than two out of the first three questions, and not more than seven altogether.]

4. Give a description, with drawings, of a high resistance astatic reflecting galvanometer, with high insulation in all parts.
5. Give a description, with drawings, of the construction of a differential galvanometer. Describe fully the mode of adjusting the two coils, so that they may have equal resistance, and also equal magnetic effect.
6. Describe, with detailed drawings, the best form of "influence machine" with which you are acquainted, and explain the principle of its action.
7. How would you make a cheap resistance, the magnitude of which could be altered at will, to be used for strong currents? Give a drawing of the details, and a specification for the guidance of the maker.
8. Write out a specification of a good form of cheap electric trembling bell. What kind of cells would you use for bells, and why?
9. What are the conditions to be fulfilled in a key to be used

* Questions 1, 2 and 3 are the same as in the Ordinary Grade, and this applies to both grades in electrical instrument making.
—EDS. ELEC. REV.

with a Wheatstone's bridge? Describe fully a simple form of key fulfilling these conditions.

10. Describe, in detail, the construction of a permanent magnet, mentioning the brand of steel to be used, and the country from which it should be obtained, the size and shape of the piece of steel employed, the mode of hardening, tempering, and of magnetising.

11. Explain the various shapes it would be desirable to give to the pole pieces of an electromagnet, so as to obtain the maximum effect in various cases. State fully under what circumstances you would adopt each shape.

12. Give a drawing of a shunt box having high insulation. Prove what should be the resistance of three shunts, so that $\frac{1}{10}$ th, $\frac{1}{100}$ th, and $\frac{1}{1000}$ th of the total current will pass through a galvanometer of 8,600 ohms resistance. What kind of wire would you use for the shunts, how would you wind it, and where would you place it to diminish the temperature error as much as possible?

13. In the construction of resistance boxes, what should be the relative diameters of the wires used in making the 1 ohm and the 1,000 ohm coils? Give full reasons for your answer.

14. Describe, with drawings, a telephone transmitter and receiver. Explain fully why an induction coil should be used with the transmitter when the length of the telephone line is considerable.

15. Give a drawing of a good switch for an incandescent lamp, and mention what are the characteristics of a good switch for this purpose.

16. You are required to solder together two copper wires in a galvanometer. What flux would you use, and why? Give a sketch of the joint you would make, 1st, if the copper wires were thin; 2nd, if they were stout wires.

17. Two electromagnets having iron cores and bobbins of exactly the same size and shape are wound, the one with a copper wire 0.01" diameter, the other with a wire 0.02" diameter, so that the external dimensions of the bobbins, when wound, are also the same in both cases. Calculate the relative strengths of the currents required to be used, so that the strength of the two electromagnets may be the same.

HONOURS GRADE.

[Candidates are not to answer more than one out of the first three questions, and not more than seven altogether.]

4. Describe, in detail, giving sketches, some form of apparatus especially adapted for measuring small resistances, and prove the formula employed in using the instrument.

5. Describe, in detail, giving sketches, an apparatus which may be used for measuring, with one observation, a resistance when a strong current is passing through the resistance, and show exactly how it is employed when used to measure the resistance of the electric arc.

6. Describe the theory and practical construction of a "constant current shunt," that is, one which shunts the current passing through the coils of a galvanometer, without altering the total current flowing in the circuit. Give an actual example of the numerical working out of the proper values to give to the coils of a constant current shunt.

7. Give a detailed account of some instrument used for measuring large currents in amperes, and of some instrument for measuring large potential differences in volts. Explain fully, why a change of temperature may seriously affect the sensibility of the latter, while it produces, practically, no variation in the sensibility of the former.

8. Give an account, together with detailed sketches, of the apparatus employed in duplex signalling on a long submarine cable.

9. A horse shoe electro-magnet has two bobbins each two inches long and $\frac{3}{4}$ inch external diameter. If the diameter of the iron core is $\frac{1}{2}$ inch, the resistance of the remainder of the circuit 420 ohms, and the resistance of a cubic inch of pure copper 0.63 microhms, what should be the diameter of a copper wire having 94 per cent. of the conductivity of pure copper, to be wound on the electro-magnet, if the thickness of the silk be neglected? In what sort of way would you modify your answer to allow for the space occupied by the insulating covering?

10. Give a description, with detailed sketches, of a non-sparking key.

11. Certain specimens of soft iron, to be used for the cores of electro-magnets, are given you to examine. Describe, in detail, the kind of tests you would make to ascertain which specimen of iron was the most suitable for the purpose.

12. Describe, in detail, the mode of absolutely calibrating a current meter without the employment of any standard current meter.

13. Describe, in detail, the mode of absolutely calibrating a potential difference galvanometer, without the employment of any standard potential difference meter.

14. Calculate the size of plates that must be separated by a layer of air 0.01 inch in thickness, so that the air condenser may have 0.0001 of a microfarad capacity. One farad corresponds with about 10^{12} C.G.S. electrostatic units of capacity. About how much per cent. would your answer be altered if the air were replaced with paraffin wax?

15. Give a full description, with drawings, of a reflecting galvanometer for measuring capacity. What are the essential features of such a galvanometer?

NOTES.

The Electric Light in the Royal Navy.—A trial of Brotherhood's engine and the Victoria machine, with search lights, has taken place on board the *Rupert*, turret ship, at Portsmouth. Mr. Lane, electrician of Portsmouth Dockyard, conducted the trials, and the engineers of the ship have now charge of the electric branch.

Electric Lighting at Chicago.—One-quarter of Chicago, it seems, is still lighted, or supposed to be lighted, by oil lamps. A little while ago several residents of this "oil district," as it is called, appealed to the council for electric lights, stating that some of the more enterprising citizens were in the habit of borrowing the street lamps at night, returning them empty in the morning, leaving the streets in the meantime in darkness. The council has decided to light the district by electricity, and has accepted the tender of the Louisiana Electric Light and Power Company for about 300 lamps—twenty towers carrying six each at \$1,200 per year, and the balance on poles at \$146 per year.

Street Lighting by Electricity.—An experiment is being made at Lockport, N.Y., in the use of Edison lamps for street lighting, and the *New York Electrical World* says the result is awaited with considerable interest. Our contemporary remarks that "it will be remembered that a similar test on the Holborn Viaduct, in London, has been a success down to date." This will be news to our readers, as it is to ourselves. We have been under the impression that the lighting of the Holborn Viaduct, which ceased more than a year ago, was a failure in the commercial sense, whilst undoubtedly it was not a brilliant success so far as the actual lighting was concerned, for an observer proceeding through Newgate Street to the Viaduct would scarcely, without pre-knowledge, have detected where the gas lights ended and the electric lights commenced.

The Electric Light for Tradesmen's Signs.—A novel use of the incandescent light is made at the factory of Stout, Meadowcraft & Co., New York, authorised agents of the Edison lamp. A sign has been constructed in which the outlines of the letters are composed of a number of small incandescent lamps, and when the current is turned on the name of the firm stands out with distinctness and brilliancy.

Electric Headlights.—It is stated that thirty-five passenger engines on the Vandalia main line are to be equipped at once with the American electric locomotive headlights.

Incandescence Lamp Patents in America.—The *New York Electrical World* has been at considerable trouble, it states, to give its readers so early a definite idea as to the main issues in the suits brought by Mr. Edison's representatives in defence of his patents. We have reproduced in our other columns the article of our contemporary, consequently the following remarks will be of interest to our readers:—"It is, of course, far too early to fix a time for the settlement of the matter. We believe the answers are not returnable until July, and of course where there is such an array of counsel and experts as suits of this important nature always require, years may be exhausted before a decision is arrived at. The Bell-Drawbaugh case will be fresh in the minds of many, as will also the Brush-Weston suits, brought to an end last year, though begun as far back as December, 1880. Still, where the interests at stake are so large, and where the future of the industry itself is concerned, one can but hope for a speedy decision."

Electric Lights and Birds' Nests.—A pair of English sparrows are said to have built their nest within the glass shade of one of the electric lights in Bridgeport, Conn.

Lamp and Dynamo Tests at Philadelphia.—The Philadelphia correspondent of the *Electrical World* sends the following additional news in regard to the tests conducted there by the Franklin Institute:—At midnight on the night of Wednesday, May 6th, the 600-hour test of the electric lights at the Exhibition Buildings, in West Philadelphia, was completed, though the comparative results of the different lights will be noted up to a thousand hours. The two principal tests are of the lights and of the dynamos. The committeemen on the first are Professor Marks, of the University of Pennsylvania; Lieutenant Murdock, U.S.N.; Dr. Ward, of the Philadelphia Gas Trust; and Lieutenant Duncan, of the U.S.N. On the second the committeemen are: Commander Jewell, U.S.N.; Lieutenant Anderson, U.S.A.; Lieutenant Murdock, U.S.N.; and Professor Marks. The different lamps undergoing the test were all guaranteed for 600 hours, and although the official report will not be made till the expiration of the 1,000 hours, the following facts were learned at the Exhibition Building on Wednesday:—Of the 20 lamps submitted by the United States Company, 12 have gone out. The Stanley Company has lost 16 out of 20. Messrs. Woodhouse and Rawson have lost 9 out of their 10; and the Edison Company 1 out of 20. All have lost some candle-power (?), some more than others, but no accurate statement could be had as to the efficiency—i.e., the current necessary to send through each lamp—it was found that the Weston (U. S. Co.'s) lights required 3·6 watts per candle; the Edison, 4·4; the Stanley, 4; and the Woodhouse and Rawson, 3·8. As to the dynamo test, which will begin in about two weeks, great care is exercised in the preparations. Records have already been taken for four weeks of the engine, which goes night and day. Then the dynamometer of Mr. Tatham's invention, which has been set up to measure the dynamos, is itself subjected to a crucial test, to determine its own accuracy. According to Joule's standard the dynamometer should record a rise of one degree in water heated by mechanical agitation for every 772 pounds of weight raised one foot by the same power. Mr. Tatham's dynamometer has been shown to record one degree for 770 foot-pounds of energy, being to absolute accuracy as 770 is to 772. Only six dynamos are now in the building for testing; three of the Edison and three of the Weston pattern, but more are expected. The tests will not be finished before the middle of June.

Lighting of a New York Theatre.—The Peoples' Theatre, Bowery, is to be lighted with the Edison system shortly. A 400-light plant has been contracted for.

Electric Lighting of Ottawa, Canada.—The Royal Electric Company, of Montreal, has completed the arrangements under its contract for lighting the city of Ottawa with the Thomson-Houston system, and the lamps were first lit on May 1st.

The Electric Light in Workrooms.—Messrs. Paterson and Cooper fitted, about six months since, a trial installation of about 15 incandescent lamps at Messrs. Thos. Adams and Co.'s, the well known lace manufacturers at Nottingham. This has given such satisfaction that they have now received orders to extend the system to the greater part of the workrooms on the premises, and also to the portion used as a chapel for the employes.

The loom sheds of Messrs. Hudson, Sykes and Bousfield, at Morley, near Leeds, have been fitted with incandescent lamps. The class of goods woven here requires a light at each side of the loom, and 12 C.P. Swan lamps are for the most part employed. The installation consists of 320 12 C.P. lamps, and 60 of 20 C.P., worked from one of Paterson and Cooper's Phoenix dynamos. The whole arrangement has been carried out by this firm, and it is now employed every night from sunset to sunrise throughout the week.

Lighting of Newspaper Offices.—The *New York World* is about to light its offices with 350 incandescent lamps.

National Association of British and Irish Millers.—The second annual convention of the National Association of British and Irish Millers will be opened at Glasgow on Tuesday, the 16th inst. The Wednesday's sitting of the convention will be occupied with the reading and discussion of papers of much professional interest to the members. The subject of "Belt-Driving" is to be dealt with in one of the papers, the author being a member of an eminent local firm of machinery belt manufacturers; and Mr. Hartnell, of Leeds, will read a paper on "Electric Lighting for Flour Mills." That was also the subject of a paper read at last year's convention by Mr. Greenhill, of Belfast. Incidentally, it may be stated that there is only one mill in the Glasgow district in which the electric light has been introduced; it is the mill owned by Mr. James Marshall at Ibrox.

Admiralty Fittings.—We understand that the tender of Messrs. Goolden and Trotter has been accepted for over eleven thousand electrical fittings, of which a considerable quantity has already been delivered.

The Portsmouth Telephone Exchange.—At the last meeting of the Portsmouth Chamber of Commerce the Chairman stated that the Western Counties and South Wales Telephone Company, the promoters of the recently-established exchange, had kindly connected their Chamber, free of cost for six months, for the use of the members. The exchange, he regretted to say, had not had the acquisition of members that was anticipated, but he supposed it would grow in due course. There was a question as to all the public institutions being connected with the exchange, and if this was done the practical value of the latter would be greatly enhanced. For the exchange to be of any utility to business men there must be a large number of subscribers, and he was glad to hear that a good many had promised to join. A member present pointed out that it was exceedingly awkward for persons holding Post Office licenses, who would have to wait until their agreements expired.

Some difficulty (says our Portsmouth correspondent) has been experienced in getting those to join who would fain wait until the subscribers number more than they do at present. In order to surmount this difficulty the company has offered exceptional advantages to persons who will join at once, and it is surprising under these circumstances that many more have not availed themselves of the proffered opportunities for inter-communication. But perhaps another reason why the subscribers have not joined so rapidly as was expected is the fact that although Portsmouth is one of the largest towns in the United Kingdom, having a population of nearly 150,000, commercial interests are not paramount. It is essentially a naval and military town, and of course all the principal Government offices have been for a long time past connected by telephone. However, there is no reason why the exchange should not prove a success presently, but the company must be prepared to work slowly but surely.

Lancashire and Cheshire Telephonic Exchange Company, Limited.—This company is evidently making rapid progress. It has just issued a supplemental list showing the subscribers recently connected—a goodly number. We see that it is developing both the trunk-line and the call-office systems to a considerable extent, affording evidence of the justness of the concessions made last year by Mr. Fawcett.

The Telephone in Scotland.—The National Telephone Company is also gaining ground rapidly, its extensions in Scotland being numerous and successful. Its list of subscribers for the Scottish North-Central district comprising the counties of Forfar, Perth, and part of Fife, is to hand; from it we learn that the subscribers in Dundee number 750, and in Perth 135.

A Model Telephone Exchange.—The New York *Electrical World* has the following remarks anent the letter of "Denshin," which appeared in the REVIEW for April 25th:—"Some time ago we published an article on the working of the telephone exchange in Brooklyn. The article was reprinted in full by the London ELECTRICAL REVIEW, and drew forth some sneers at the exchange from a writer who signs 'Denshin,' and who assumes that in describing a model exchange in Brooklyn the author was ignorant of the multiple switch board and its advantages, and that the apparatus in Brooklyn was of the most improved pattern. The Brooklyn office is equipped with one of the first and simplest switch boards introduced, known as the Western Electric Standard. It is the comparatively small number of operators in proportion to the number of subscribers and amount of business, together with the admirable discipline maintained, that justifies its being called a model exchange. In regard to lightning arresters, it is an error to suppose that subscribers' instruments are not protected. They have the usual protectors furnished by the manufacturers. At the central office no lightning arresters are in use. Five years' experience in Philadelphia and Brooklyn show that no annunciators have been burned in the large offices, although the lightning is very severe every summer at both places. In the smaller or branch offices, where the number of wires is limited, the usual lightning arresters are always put in; but in spite of this the annunciators at these places are damaged by lightning more or less every summer. 'Denshin' confuses 'faults' with 'misconnections,' or failures to connect, and has the hardihood to complain that the average cost per message was not figured out on the single day's business referred to in our article."

The Brighton Telephone Exchange.—This exchange is, we hear, progressing satisfactorily, and the number of subscribers at the present time is 150. The utility of telephonic communication is greatly appreciated at the "Queen of watering places."

The Missing Cable Ship.—On Thursday the Wreck Commissioner resumed his inquiry into the loss of the ss. *Magneta*. The Court, in giving judgment, observed that any suggestion as to the cause of the loss of the vessel must be founded on mere conjecture, and the only conclusion they could form was that possibly a beam sea may have broken into the engine room and thus swamped the vessel. They condemned open sides for vessels likely to encounter bad weather, but exonerated builders and owners in this case from any blame in the matter.

A Telephone Conference.—Invitations have been issued by the American Bell Telephone Company to each of the companies operating and licensed under its patents, to send a delegate to a conference, which is to meet in Boston on the 8th of June, and to continue its session for five days, during which period the delegates will be the guests of the American Bell Telephone Company. Besides the delegates representing the several companies, a number of other gentlemen interested in telephonic enterprises and experienced in telephonic work have been invited, and the conference promises to be the largest and most important gathering of telephone men that has ever assembled. The various licensees of the American Bell Company consider themselves aggrieved by the heavy royalties exacted, and it is anticipated that this and other kindred matters will form a considerable part of the discussions.

The Reis Telephone.—An exchange contains a notice requesting all persons who experimented with or used the Reis telephone before the year 1876 to send their address to Briesen and Steele, 229, Broadway, New York.

The Telephone in Dundee.—The first telephone was placed in Dundee in 1879, and there are now in operation 915 telephones and 628 miles of wire in the district.

The Proposed Cable to Singapore.—With regard to the proposed cable between Hong Kong and Singapore, Sir George Bowen, at a meeting of the Hong Kong Legislature, announced that the Eastern Extension Telegraph Company would require a guarantee of £20,000 a year for twenty years, before undertaking to lay a direct cable. *The Colonies and India* says:—"There is, therefore, no prospect at present of the scheme being carried out, especially as both the Legislatures of Hong Kong and Singapore agree that the present condition of their revenues does not allow them to offer any substantial aid to the project."

Cable Interruption.—The Eastern Telegraph Company notifies the interruption of its duplicate Aden-Bombay cables. Until they are repaired, telegrams for India, China, &c., should be sent through the Indo-European Telegraph Company.

Telegraph Revenue.—The receipts upon the telegraph service from April 1st to May 30th, 1885, amounted to £280,000; they were also £280,000 from April 1st to May 31st, 1884.

The Telegraph Corps in the Soudan.—Two sections of the Telegraph Corps are coming home from Egypt in the *Persian Monarch*.

Secondary Batteries.—Professor John Trowbridge is rather severe, unfairly so, we think, in his condemnatory expressions anent secondary batteries. He is evidently unacquainted with the progress which has been made, in this country at all events, in improving these apparatus, and, therefore, his comments must be taken for what they are worth. To say that the working life of secondary batteries is under a year, and that at their best they cannot be depended upon, is, to say the least, a grave misstatement of known facts. Will some of our readers bring their experiences to bear upon Mr. Trowbridge pending his future utterances?

The Electrical Transmission of Power.—The author of the paper, "Niagara Falls as a Source of Electrical Energy," speaks of the insulation of an overhead conductor to carry 240 amperes a distance of 300 miles under an E.M.F. of 80,000 volts as being a comparatively simple thing. There are matters to take into consideration in insulating wires other than that of the mere sparking distance, and we should much like to test the absolute insulation resistance of such a conductor. Naturally, in this, as in telegraph wires, the points of leakage would be similarly situated, and if we find it difficult to secure on ordinary lines a moderate insulation in unfavourable weather, how much more would these difficulties increase when dealing with 300 miles of $\frac{1}{2}$ -in. copper? It may be urged that such a conductor would be covered throughout its length, whereas telegraph wires are uncovered; this would scarcely help us, but rather add to the obstacles to be overcome.

Dangers experienced by Linemen.—A telephone lineman had a painful experience the other day at Philadelphia. He was on a pole tightening wires, and imagining that in the daytime the electric light wires were free from danger, he caught hold of one, the result being that he received a shock which rendered him insensible. He hung on to the wire until his fingers were badly burned, when he fell and was caught on a wire by the strap of his climbers. He remained suspended in the air, head down, for several minutes, when he was rescued and taken to a hospital, where he was restored to consciousness. One finger was burned entirely off, and another and the thumb were amputated.

The South Australian Postmaster-General.—Mr. Charles M. Todd, the Postmaster-General and Government Astronomer of South Australia, who is on his way to England, has left Adelaide in the R.M.S. *Khedive*.

Do Telegraph Wires Foretell Storms?—Under this heading Mr. Wm. H. Babcock, writing to *Science*, says:—"Probably some thousand Americans have noticed the automatic storm-signalling of wires by sound-vibration. I allowed a telephone-wire to remain for a long time attached to one corner of my (frame) house because of its practical utility as a weather-prophet. When not a leaf was stirring in the neighbourhood, and not a breath to be felt, the deep undulations were audible in almost every room, although mufflers had been duly applied. Before that, some hours in advance of every severe storm, the upper story was hardly inhabitable on account of the unearthly uproar, which would have made a first-rate case for the Society for Psychical Research. The warning that it gave varied from six to twelve hours, rarely exceeding the latter; and I do not think it ever warned in vain. When the storm actually came, the noise nearly always ceased. It never was noticeable in the warmer part of the year; and through the heat of the midsummer it was silent. I cannot recall any exception to this. Its climax of clamour was reached some hours before the 'electric storm,' as it was called, of November, 1882. But all through two winters and the proximate parts of autumn and spring I found it a trustworthy and self-announcing storm-signaller, which left me abundant time to prepare. I had it removed, finally, because there was sickness in the house, and its doleful prophecies were not appreciated. I explained the phenomenon, partly at least, by the effect of very distant air-impulses transmitted in sound-waves from wire to wire, after the manner of the acoustic or mechanical telephone. Yet this does not seem quite adequate, when one considers how far those vibrations must have travelled to out-strip a storm by hours; and yet how much energy and sonorosity they retained when they reached me!" The editor of *Science*, in allusion to this letter, says:—"We have good authority for saying that the vibrations of the telephone and telegraph wires here referred to are certainly not due to electric currents, nor to the minute acoustic waves of the mechanical telephone, but are simple transverse vibrations and longitudinal waves such as occur on every stretched cord that gives out a musical note. These vibrations are ultimately caused by the wind. For any given wire stretched in a permanent location there will undoubtedly be a certain direction and character of wind that will call forth its loudest tones. Our correspondent's wire may be specially influenced by the southerly winds that precede storms. Sometimes rapid alternations of sunshine and shade, by heating and cooling the wire, cause it to elongate and contract rapidly, and maintain an additional series of musical notes. Sometimes the length and tension of a wire stretched between two telephone supports is such that it can harmonically respond to several classes of waves transmitted from distant parts of the line. We thus obtain the very rich effects of the Æolian harp, which, as is well known, has often been said to ring out the finest notes before a storm, and whose action was also attributed to magnetism and other occult causes, until Chladni gave the correct explanation."

The Postmaster-General and Railway Telegraphs.

On Wednesday a case came before the courts respecting the amount of compensation the Postmaster-General should pay the Great Western Railway Co., in respect of the telegraphs over a certain portion of its line. The total extent of the claim, which relates to the whole period since 1869, was about £37,000, together with a yearly rental of £1 3s. per mile per wire over the whole of the company's lines. Judgment was reserved.

Electric Railway Patents.—In the action "*Siemens v. Field*," relating to alleged infringements of patents for electro-magnetic railways, which has been some time before the courts of the United States, the Acting-Commissioner of Patents, Mr. Dryenforth, has just affirmed, upon appeal, the decision of the Examiners-in-Chief in awarding priority to Field.

The Electrical Transmission of Power.—We have not yet (*Bulletin International des Telephones*) received an authorised explanation of the unsatisfactory results of M. Marcel Deprez's tests of the dynamos constructed according to his designs. Defects in the mechanical construction and insufficient insulation of the wires have been suggested, but it seems that these are not the only causes. On the contrary, it is a question of remaking the machine integrally; which would lead us to suppose that the evil is not in such or such a detail, but in the principle itself, adopted by the inventor. We would, therefore, attribute to the so-called Foucault currents the absolutely insufficient rendering shown in the preparatory trials. This is not the first time that we have heard of Foucault currents, and a long time before the question of transmission of power to a distance was raised, one of the most distinguished electricians, Dr. Froelich, had pointed out the difficulties which they caused. In April and May, 1881, therefore, more than four years ago, this savant published, in the *Elektrotechnische Zeitschrift*, a remarkable study on dynamo-electric machines and the transmission of power by electricity. On comparing the theoretical formulæ with observed results, he was struck by a want of concordance, which he explained by the action of the Foucault currents, that is to say, the induction currents which are produced in the iron of the ring. "The principal cause of these currents," said he, "is the action which the magnetism of the electro-magnets exercises upon the iron core of the ring; in consequence of the rotation, currents must be established in this iron in the same manner as in the copper wire. In the primary machine (generator) the currents of induction weaken the electromotive force and increase the energy absorbed; in the secondary machine (receiver) these currents of induction strengthen the electromotive force and diminish the energy produced." In the numerous experiments which led to these conclusions, the work done was always in reality less and, on the contrary, the electromotive force of the secondary machine greater than theory indicated. Dr. Froelich thus made evident a fact which deserved attention, namely, the necessity of knowing exactly what to understand by the term Foucault currents. The phenomena do not seem yet to have been elucidated, and the first test of the machines at Creil shows that there still remain many obscure points, even in theories considered the most perfect. In the previous trials at Munich, and at the Gare du Nord, M. Marcel Deprez had no such surprise, because he worked with machines of comparatively low power, and he employed Gramme dynamos, in which a few details only had been modified. With new types he must proceed with studies which are the more necessary as the labours of his predecessors can not serve him in the path in which he is engaged.

Wanted.—To know what the liquidators of the following companies are doing in their respective liquidations:—The Jablochkoff Electric Light Company; The Duplex Electric Light Company; The Electric Carbon Company of Scotland; The St. George Telephone Company; and The Lancashire Maxim-Weston Company.

The Society of Telegraph Engineers and Electricians

—An extraordinary meeting of this Society will be held on Thursday, June 11th, at 8 p.m., when a paper "On the Calculation of Mains for the Distribution of Electricity" will be read by Mr. W. H. Snell.

Dissolution of Partnership.—Messrs. Norton & Co., of Blackburn, electrical engineers, have notified the termination of their partnership.

Personal.—Sir Charles Young, Chairman of the Hammond Electric Light Company is, it is said, about to accompany Mrs. Cecil Clay (Miss Rosina Vokes) on a professional tour through the United States. Mrs. Clay will produce a new piece written especially for her by Sir Charles.

Bennett's Improved Voltaic Cell.—Alluding to a description given by the *Scientific American* of his voltaic cell, Mr. A. R. Bennett, of Glasgow, gives the following particulars respecting the improvements he has effected:—"The battery is now extensively used in this country, especially for telephone transmitter work. Some telephone exchange systems use no other. The experience thus gained has led to the improvement of the battery in some respects, especially in regard to the form of the zinc plate. Such a plate as is depicted in your illustration is liable to be quickly eaten through at the water line, whether the cell works or not. Zinc rods are subject to the same destructive action when they are partly in and partly out of the solution. The zinc is now placed entirely under the surface of the solution, and a brass wire, covered with rubber tubing, brought up from it for the purpose of forming the connection. This wire is soldered into a deep hole drilled in the zinc. The tubing is then slipped down the wire until it reaches the bottom of the hole, which is then filled up with melted sulphur. When this is properly done, the zinc is eaten away only in proportion to the work performed by the battery. The zinc should always be amalgamated. The rubber should cover the wire well beyond the surface of the solution. The solution should be always caustic potash, as caustic soda creeps up and makes a very dirty cell. When the battery is intended for permanent work, the outer pot should be of cast iron. This is no better electrically, but lapped and soldered pots are not trustworthy for a long period. For long continued use the porous pot should not be less than $6 \times 3\frac{1}{2}$ inches, and the charge should be six ounces of caustic potash. The battery may be made to give a much stronger current—equal to 2 volts—by mixing one ounce of per-manganate of potash with the iron borings, and filling them up with the caustic potash solution. It should be noted that unless per-manganate of potash is used, no caustic potash solution is put with the borings, except what filters through the porous pot."

American Institute of Electrical Engineers.—The first annual meeting of the American Institute of Electrical Engineers was held on the 19th of last month, when the following officers were elected:—President, Dr. Norvin Green; vice-presidents, D. H. Bates, Professor E. A. Dolbear, Francis W. Jones; managers, Charles L. Buckingham, David Brooks, T. C. Martin, George M. Phelps, jun., Professor B. F. Thomas, W. D. Sargent; treasurer, Colonel Rowland R. Hazard; secretary, Ralph W. Pope. On the succeeding day the following papers were read and discussed:—"The Protection of Electrical Inventions," by Mr. Frankland Jannus, Washington, D. C.; "The Cost of Mine Lighting," by Mr. F. P. Mills, Stambaugh, Mich.; "The Storage Battery in Commercial Use," by Mr. E. P. Roberts, M. E., of Cheyenne, Wyo.; "The Arc Lamp Frictional Clutch," by Mr. E. P. Thompson, M. E., New York; and "The Delany Facsimile Telegraphy," by Prof. G. J. Houston, of Philadelphia. The Institute numbers after but one year of existence 279 members and associates.

Incandescent Lamp Patents.—In view of possible litigation in this country on the subject of incandescent lamp patents, we have reproduced from our American contemporaries some interesting and useful matter. In the United States legal proceedings have commenced, and threaten to be of longer duration and of greater moment even than those in which the telephone has so largely figured.

Technological Examinations.—We publish in our current columns a series of examination questions set for the technological studies in connection with the City and Guilds Institute. We shall be pleased to receive any communication bearing thereon from those of our readers who may feel either directly or indirectly interested in such matters. It is not by any means an

easy task to compile a series of questions, the answers to which may be taken as a fair estimate of the student's knowledge of the course of study through which he has been taken.

The School of Electrical Engineering and Submarine Telegraphy.—The *Daily News*, in its issue of the 2nd inst., devotes over a column to a description of this highly successful and progressive Technical School in Hanover Square. The fact that such eminent authorities as Professor Fleming Jenkin and Mr. W. H. Preece have sent their sons there to undergo the course of instruction is significant of the high position which the institution has taken under the energetic management of Mr. W. N. Tiddy and Dr. Lant Carpenter. Sir William Thomson quite recently, in referring to the school, says:—"Nearly eleven years ago I expressed a favourable opinion regarding the efficiency, for the teaching of submarine telegraphy, of an institution which has continued doing good work ever since that time, and which now has a well-deserved reputation as the School of Electrical Engineering and Submarine Telegraphy, of Princes Street, Hanover Square. A few days ago I had the pleasure of again visiting it, and was much pleased to find large extensions from its original province of submarine telegraphy into all branches of electrical engineering, while still retaining all its efficiency in the practical teaching of telegraphy. It is now well equipped with apparatus and appliances for the teaching of electric measurement, photometry, the management of dynamos, the practice of electric lighting, and other commercial applications of electricity. With these valuable adjuncts for illustration and practical exercise, the fundamental scientific principles are methodically taught in a series of systematic daily lectures and examinations under the superintendence of Mr. Tiddy and Mr. Carpenter, and their able assistants, in a manner which seems to me exceedingly well adapted to benefit their pupils." Examinations by an independent examiner are conducted at the end of the courses, and those who obtain 70 per cent. of the total marks at the termination of the final course are granted a vellum certificate. The percentage of marks required is undoubtedly high, but the school authorities have done wisely in fixing it at such a limit, as the value of the certificate under these conditions becomes most pronounced.

Cardew's Voltmeter.—We have noticed on various occasions a peculiar feature in the action of one of these instruments, which the inventor himself could probably best explain. The voltmeter in question is used for measuring the E.M.F. of a set of secondary batteries, and when 50 cells are put in connection therewith it registers 100 volts. If two cells are now cut off it indicates quite correctly 96 volts. Now if the needle be allowed to fall back to zero for a moment and contact be again made, the instrument invariably stops at 93 volts, and does not rise to its former indication of 96, however long the contact may be kept on. What is the explanation?

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Jablochhoff and General Electricity Company, Limited.—The statutory return of this company, made up to the 20th ult., was filed on the 27th ult. The nominal capital is £20,000, in £100 shares. 75 shares have been taken up, and the full amount has been called and paid thereon. Registered office, 36, Albert Embankment, Lambeth, S.E.

Bullion and Metal Refinery Company, Limited.—An agreement of 19th ult., filed on the 1st inst., ratifies an agreement of the 8th ult. relating to the purchase

from Messrs. Walter Wood and Edward Easton of their interests under an agreement of 4th ult. for the purchase of certain inventions, &c., from the Electrolysis Company, the consideration being £5,000 in fully paid shares and £200 cash.

Anglo-American Brush Electric Light Corporation, Limited.—The annual return of this company, made up to the 18th February, was filed on the 29th ult. The nominal capital is £400,000, in £5 shares. 17,697 shares are fully paid, and £3 per share has been called and paid upon 23,003 shares. The paid up capital amounts to £157,494. 102 forfeited shares have been reissued as £5 shares with £3 paid up. Since the filing of last year's return the capital of the company has been reduced from £800,000.

Electrical Power Storage Company, Limited.—An agreement, dated 29th April and filed 30th ult., between the Indian and Oriental Electrical Storage and Works Company, Limited, and this company, states that this company is entitled to call upon the Indian Company to issue and allot to the Storage Company 10,000 fully paid deferred shares upon producing the certificates of 5,000 fully paid ordinary shares in the original company, and that the Indian Company is entitled to call for an assignment at their own expense of the Sellon, Faure, and the Johnson, Swan, Swan-Sellon, Volckmar and Phillipart Indian patents. Meetings are to be held of both companies approving this agreement, and upon its confirmation the Indian Company will sell and the Storage Company will purchase the said patent rights, the consideration being 15,000 fully paid shares in the Storage Company.

Indian and Oriental Electrical Storage and Works Company, Limited.—At an extraordinary meeting of this company, held on the 11th ult. at 19, Great Winchester Street, the agreement with the Electrical Power Storage Company, Limited, providing for the sale of the Indian Company's patents, &c., and for the eventual liquidation of the Indian Company, was adopted. The resolution was confirmed on the 27th ult. and filed on the 30th ult.

CITY NOTES.

Brazilian Submarine Telegraph Company, Limited.

—The directors of this company have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, free of income tax, for the quarter ended 31st March last, and payable on the 24th inst.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of May was 4,474, estimated to produce £3,700, against 3,839 messages, producing £2,973 in the corresponding month of last year. The receipts for the month of February, estimated at £2,700, realised £2,730.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending May 29th were £2,346, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st May, are £3,813, as compared with £3,245 in the corresponding period of 1884.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of May were £1,345, against £1,532 in the corresponding period of last year.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph-Engineers and Electricians.

An ordinary general meeting of this society was held on Thursday, May 28th, Mr. C. E. SPAGNOLETTI, President, in the Chair.

The minutes of the last ordinary general meeting having been read and confirmed, and the list of transfers and new members announced, a paper by Mr. B. J. FARQUHARSON, on "Ship Lighting by Glow Lamps, embodying results of trial for economy in H.M.S. *Colossus*" was then read. The author commenced by stating that the object of the paper was not to describe any novelties, but simply to make a statement of facts without expressing an opinion. A list of the various rooms, &c., lighted, was then given. The object of the trial was to compare the relative costs of electric and oil lighting. The cost of labour was not taken into account, as no extra wages were paid, the oil lamp hands being replaced by electric light hands at the same cost. The first trial showed a saving on the seven days' working of £35 12s. 9d. in favour of electricity, equivalent to £1,852 for the year. The large failure of the lamps which took place was no doubt due to the high incandescence which it was necessary to give them in order to develop the full nominal candle-power. The engines used were of the Brotherhood type. The general result of the trials was so favourable that the general adoption of electric lighting in all the large war ships was practically decided upon, and no doubt the smaller ships would also be fitted with the light. Tables A and B show the actual results of the trials.

TABLE A.—H.M.S. "COLOSSUS."

Summary of Seven Days' continuous Steaming of Electric Engines.—January 15th to 22nd, 1885.

Date.	Pressure of Steam.		Temperatures in Degrees Fahrenheit.				Revolutions per Minute.			Total Oil Consumed.				Oil for Electric Engine only (Crane's Mineral).		Total Coal consumed (Tyler's Merthyr).		Cotton Waste (Coloured).	REMARKS.
	In Boiler.	At Electric Engine.	Feed Water.	On Deck.	Dynamo Room.	Stoke Hold.	Electric Engine.	Fan Engine.	Donkey for Auxiliary Condenser.	24 hours.			Per Hour.	24 hours.	Per Hour.	24 hours.	Per Hour.		
										Crane's Mineral.	Olive.	Total.							
1885. Jan. 15	61	39	72	36	85	63	383	337	—	Pts. 12	Pts. 8	Pts. 20	Pt. '83	Pts. 7	Pt. '29	Cwt. 38	Cwt. 1'58	Lbs —	Coal used for lighting up = 17 ct. Fan engine kept running. Feed donkey as required, and fire engine running slowly for auxiliary condenser.
„ 16	52	43	78	37	86	63	389	370	—	8	6	14	'58	7	'29	46	1'92	1	Fire engine stopped at 2 p.m., and bilge donkey substituted for circulating water through auxiliary condenser.
„ 17	53	43	77	36	82	63	397	363	44	9	2	11	'46	6	'25	47	1'96	2	Fan engine and bilge donkey running throughout; feed donkey as required.
„ 18	52	45	78	37	81	63	396	343	41	6	6	12	'50	5	'21	49	2'04	1	Do. do. tubes swept soon after midnight.
„ 19	52	42	78	37	79	64	402	342	45	7	6	13	'54	7	'29	47	1'96	1	Engines as before.
„ 20	52	44	77	32	76	62	383	327	43	7	4	11	'46	6	'25	49	2'04	1	Do.
„ 21	52	45	81	32	74	62	378	347	38	8	4	12	'50	7½	'31	47	1'96	1	Do. Lights as at quarters from 10 a.m. to 2 p.m.
Totals	374	301	541	247	563	440	2,728	2,429	211	57	36	93	3'77	45½	1'89	Tns. Ct. = 16 3 323	13'46	7	
Means	53'4	43	77'3	35'3	80'4	62'8	389'7	347	42'2	8'14	5'14	13'28	'55	6'5	'27	46'1	1'92	1	

24 Hours' run to ascertain the Coal consumed under the same conditions as above, with Electric Engine stopped.

Jan. 22	51	—	83	34	—	62	—	349	44	½	4½	5	·21	—	—	14	·58	1	Fan engine and donkeys as above, and steam in pipes up to electric engines.
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Started at 7 a.m. on 15th January, and stopped electric engine at 7 a.m. on 22nd instant, the above observations being the means of each 24 hours. Engines worked continuously as follows:—

No. 1 engine from 7 a.m. on 15th to 9 a.m. on 16th = 26 hours.
No. 2 do. 9 a.m. on 16th to 9 a.m. on 18th = 48 do.
No. 3 do. 9 a.m. on 18th to 9 a.m. on 20th = 48 do.
No. 1 (2nd time) do. 9 a.m. on 20th to 7 a.m. on 22nd = 46 do.

Total 168 hours.

Reducing value on No. 1 gave some trouble on first run, necessitating changing over to No. 2 engine, but this was afterward remedied, and with this exception the engines worked in a very satisfactory manner throughout.

Engines exhausting into auxiliary condenser at atmospheric pressure.

Total clinker and ash = 1,145 lbs. in 7 days for 323 cwt. of coal = 3·16 per cent.

Fresh water used for feeding boiler.

Total coal used per 24 hours = 46 cwt. Coal used for maintaining steam under the same conditions with electric engine stopped = 14 cwt.; leaving 32 cwt. per 24 hours as the additional expenditure that would probably be required for electric engine when the boiler is already in use for other purposes.

	£	s.	d.
Cost per week—Coal, 32 cwt. per day, at 15s. per ton (Rate Book price)	8	8	0
Oil, Crane's, 6½ pints per day at 2s. 2d. per gallon	0	12	4
Waste, 1 lb. per day at £1 12s. 6d. per cwt.	0	2	0
Total per week	£9	2	4

TABLE B.

Showing the Average of Readings obtained at the Seven Days' Trial of Electric Light Dynamos fitted in "Colossus."

Date.	No. of dynamo.	Duration of trial.		Speed.	Current.	E.M.F.	Candle-power.		No. of lamps burning.		Steam pressure on		Temperature, Fahrenheit, dynamo room.	No. of lamps broken.		Sperm Oil consumed.	Waste consumed.	REMARKS.
		From	To				Full.	Half.	Full.	Half.	Engine.	Boiler.		Full.	Half.			
15.1.85	No. 1	7 a.m.	6 p.m.	377	119·25	79·5	20	9·8	142	48	41	57·25	81·8	1	—	2 pts ½ lb.		
	Do.	6 p.m.	9 p.m.	374	183·6	79·5	20	9·8	193	106	42·8	58·5	86·6	1	5			
	Do.	9 p.m.	11 p.m.	391	155	79·5	20	9·8	190	49	30·0	60	87	0	1			
	Do.	11 p.m.	7 a.m.	394	117·3	80	20·8	10·0	149	30	34·6	66	87	0	0			
16.1.85	No. 1	7 a.m.	6 p.m.	373·7	117·25	78·25	19·8	9·2	141	48	35·7	58	86·5	0	0	1½ ,, ½ ,,		
	No. 2	—	—	399	118	79·7	20	9·8	141	48	39	50	88	2	1			
	Do.	6 p.m.	9 p.m.	393	180·7	79·2	20	9·8	192	103	45	48	86	2	0			
	Do.	9 p.m.	11 p.m.	391	147·25	79·8	20	9·8	184	41	35	47	86	0	0			
17.1.85	Do.	11 p.m.	7 a.m.	397	113·26	79·7	20	10·0	142	30	48	49·6	86	0	0	2 ,, ½ ,,		The change of load from No. 1 to No. 2 dynamo was made at 9 a.m.
	No. 2	7 a.m.	6 p.m.	398	119	80·9	20·8	10·7	141	48	34	50	82·5	4	3			
	Do.	6 p.m.	9 p.m.	395	172·3	78·7	19·8	9·5	181	98	45	49	83	5	1			
	Do.	9 p.m.	11 p.m.	399	150·5	80·1	20·8	10·6	188	41	46·5	49	83	2	1			
18.1.85	Do.	11 p.m.	7 a.m.	396	116·2	80	20·8	10·6	145	28	48·6	50·4	82	0	1	2 ,, ½ ,,		The change of load from No. 2 to No. 3 dynamo was made at 9 a.m.
	No. 2	7 a.m.	6 p.m.	398	118	80	20·8	10·6	141	48	37·5	50	82	0	0			
	No. 3	—	—	395	113	78·9	19·8	9·6	131	45	42	50	83·3	2	1			
	Do.	6 p.m.	9 p.m.	400·5	170·3	78	19·8	9·6	180	97	46	51	80	1	1			
19.1.85	Do.	9 p.m.	11 p.m.	400	141·4	78·6	19·8	9·6	190	39	46·7	50	79·6	0	1	1½ ,, ½ ,,		
	Do.	11 p.m.	7 a.m.	399·7	112	80·5	20·9	10·6	140	28	45	50·5	79	0	0			
	No. 3	7 a.m.	6 p.m.	400·8	115·2	80	20·8	10·6	139	42	39·9	50·4	79	0	1			
	Do.	6 p.m.	9 p.m.	407	174·5	79	20	9·8	180	103	47	53	79·5	1	0			
20.1.85	Do.	9 p.m.	11 p.m.	400	140·8	78·7	19·8	9·6	190	39	41	44	79	0	0	1½ ,, ½ ,,		The change of load from No. 3 to No. 1 dynamo was made at 9 a.m.
	Do.	11 p.m.	7 a.m.	402	107	80	20·8	10·6	134	28	45	50·6	78	0	1			
	No. 3	7 a.m.	6 p.m.	400	114	80	20·8	10·6	134	43	44	50	80	1	0			
	No. 1	—	—	383	118	80·4	20·9	10·6	141	48	43	50	78	2	3			
21.1.85	Do.	6 p.m.	9 p.m.	392	180	80	20·8	10·6	192	103	44	50	76	2	1	½ ,, ½ ,,		The price of £ s. d. lamps ... 0 3 6 each, oil (sperm) 0 6 0 per gal. waste ... 1 12 6 cwt.
	Do.	9 p.m.	11 p.m.	386	147	80	20·8	10·6	184	41	45	50	76	2	1			
	Do.	11 p.m.	7 a.m.	381	109·6	80	20·8	10·6	138	28	46	50·4	74	3	0			
	No. 1	7 a.m.	10 a.m.	378	117	79	20	9·8	141	48	45	54	72·5	2	1			
	Do.	10 a.m.	2 p.m.	379	146	78	19·6	9·6	152	82	44	51	72	0	0	1½ ,, ½ ,,		
	Do.	2 p.m.	6 p.m.	380	118·5	79	20	9·8	141	48	42	52	74	2	3			
	Do.	6 p.m.	9 p.m.	382	176	79	20	9·8	181	106	43	50	75	2	1			
	Do.	9 p.m.	11 p.m.	382·5	148	79·5	20	10	184	41	44	50	75	0	0			
	Do.	11 p.m.	7 a.m.	382	111·5	80	20·8	10·6	140	28	44	48	74	1	1	Total.	38	29
																12½ ,,	3½	

NOTE.—Observations were taken every half hour. 62 lamps had their fibres broken, the remaining five had their globes broken. Total of lamps £11 14s. 6d.; do. oil, 9s. 4½d.; do. waste, 1s. 0½d. Grand total, £13 4s. 11d.

A paper was next read by Mr. J. N. SHOOLBRED, B.A., on "Electric Lighting at the Forth Bridge Works." In the autumn of 1883 Messrs. Tancred, Allen & Co. requested Mr. Shoolbred to undertake the supervision of the electric lighting of the Forth Bridge Works. The author then described the general peculiarities of the localities to be lighted, and also gave particulars of the bridge itself, remarking that the span of 1,700 feet adopted was the longest in the world. 42,000 tons of steel and 120,000 tons of stone would be used, the total cost being about £2,000,000. There were three electric light installations, one on each bank, and a small one on Inch Garvie Island. To avoid accidents the highest E.M.F. did not exceed 120 volts for the incandescence system and 300 volts for the arc system. The lighting was carried out by Messrs. Siemens and Messrs. Crompton. No hitch of any kind took place. There were 13 dynamos, 100 arc lights, and 500 110-volt incandescence lights of 20 candle-power. In order to avoid the inconvenience of constant changes in the Siemens installation, the arc lamps were arranged in groups of six to each machine, and any one group could be coupled on to any dynamo as desired. The in-door lights were connected to service boxes provided with plug switches. Messrs. Crompton's arrangements were

not so elaborate, but were perfectly satisfactory. For the mains 1,000 amperes per square inch was the limit allowed, though actually 750 was the highest actually reached. The loss of E.M.F. over the leads for the distance of half a mile was 3·25 volts theoretically, but the actual amount was less than this. In one case, where the calculated loss was 12 volts, the actual loss was only 5 volts; this was partly due to the fact that the wires being open ones were kept comparatively cool. In cases where the wires were in a hot factory the theoretical amount was exceeded. As regards carbons, the cored description were the best, though they were rather more expensive than the ordinary kind; they consumed 50 per cent. quicker than the latter. In cases where the leads were exposed to the action of the sea, India rubber coverings were useless, and bare wires answered best. Bare conductors were found to be very successful; in some cases they were bedded in troughs filled with pitch. The duration of the incandescence lamps was generally supposed to average 800 hours, but no figures could be obtained by the author to support this statement. He in practice had found that the lamps first supplied averaged 404 hours, 35 per cent. being defective. In 1884 the duration was increased to 730 hours with 20 per cent. defec-

tive; and later still the duration had been increased to 1,200 hours with only 10 per cent. defective. Some of the lamps burnt for 2,000 hours. The first lamps supplied were of the loop description, but the collar lamps afterwards used were much more satisfactory.

In the discussion which followed the reading of the papers, Mr. SHOOLBRED said that with reference to the *Colossus* trials he thought that 62 lamps broken out of 400 was a very excessive number; he thought that this might possibly be due to the lamps being run a little over their full candle-power, owing to the measuring instruments being incorrect. The measuring instruments at present manufactured were very unsatisfactory and unreliable. Sir William Thomson hoped shortly to bring out a reliable standard instrument. With regard to ship lighting, he would state that 250 lamps could be burnt at a cost of one shilling for steam, one shilling for lamps, and sixpence for depreciation, per hour, which was decidedly a cheap result.

Mr. SWINBURNE said that the life of a lamp depended almost entirely upon the way in which the latter was used, a very small percentage of excess of current—a percentage which most current measurers would not show—would seriously diminish the life of a lamp. Great care in making measurements, especially photometric measurements, was very necessary.

Professor AYRTON stated that the ordinary electromotive force standard was 4 to 5 per cent. wrong: thus 100 volt lamps were often worked up to 105 volts. A second error in measuring instruments was due to change, and a third error to extraneous forces. In his recent measuring instruments he had adopted a translation movement, which, unlike a rotatory movement, would not be affected by extraneous forces; thus there was no tendency for the earth's magnetism to bodily transport a compass, although it acted on the needle itself to induce on it a rotatory movement; for this latter reason no instrument on the compass principle could be trusted to give reliable results.

Mr. SWINBURNE (in continuation) pointed out that the temperature error should not be neglected. Residual magnetism also caused an error. He had found Crompton and Kapp's instruments correct within $\frac{1}{4}$ per cent., and Ayrton's instruments were almost as good.

Mr. CROMPTON would point out that the results shown by Mr. Farquharson's paper were not nearly so good as they might be, as it was very uneconomical to work with low pressure steam.

Dr. FLEMING thought it was very important that measurements ought to be taken on the spot where lamps were worked, and that marked values should not be relied on. As regards the commercial efficiency of lamps, this was given by multiplying the candle power by the hours burnt, and dividing the result by the price. He did not agree with Professor Ayrton that the marked values on a lamp were 5 per cent. wrong. A voltmeter ought to be calibrated on the spot where it was used with accurate standards. Sir William Thomson's graded instruments he found were not to be depended on.

Mr. A. TROTTER enquired whether the colour of the lamps showed that they were being forced.

Mr. SELLON said that he was present during the trial of the lamps on the *Colossus*, and he considered that the trial was exceptionally severe, and the great number of experiments which were tried would largely account for the breakages being so numerous; thus a sudden spurt of the engine sometimes took place. Lamps ought not to be lighted with a less power than 4 watts per candle.

Mr. A. SIEMENS stated that the *Colossus* was not the first war ship lighted electrically. The number of breakages must have been due to a bad instalment of lamps being used. The *Massilia* had made a voyage to New Zealand and back, and only one lamp had been broken; the lamps had, however, been run at a low candle power. At the Savoy Theatre there were lamps in use which had been put in in 1882. Lamps ought to be lighted up slowly, and never run too high.

Mr. WILDE considered that Cardew's voltmeter was a very satisfactory instrument, being quite unaffected by extraneous forces. Lamps which had been used at the Waterloo Station had lasted for 2,000 hours, but some had lasted a very much shorter time, although they had not been run at a high power.

Mr. WALTERS thought a great deal of the breakages were due to incipient injuries caused by rough carriage; too high burning was very fatal. He himself found the same difficulties as other people with reference to measuring instruments.

Mr. FARQUHARSON, in replying, said that the excessive heat noticed in the dynamo room was due to the engine working in a confined space, which was unavoidable. As regards measuring instruments, duplicate sets were employed of the Crompton and Siemens patterns. No very minute measurements were made. As regards the high candle power of the lamps, since the latter were marked as 20 candle power they were tried as such; possibly the incandescence was too high, though as a matter of fact it was not only those which were very white which broke.

Mr. JAMIESON, with reference to Mr. Shoolbred's paper, asked how the temperature of the leads could affect the theoretical question of the loss of E.M.F.; the latter ought to have been determined by measuring the resistance and the current. He asked whether any of the lamps were burnt under water.

Sir DAVID SALOMONS found from experience that the breakage of lamps by carriage had very much diminished; the general breakage was also much less than it used to be. He thought that Mr. Shoolbred was incorrect with reference to the loss of E.M.F. in the mains.

Mr. R. E. CROMPTON said that the electrical measuring instruments were at least as good as the steam gauges and similar appa-

ratus as regards accuracy. He spoke highly of Cardew's voltmeter.

Mr. SHOOLBRED, in replying, agreed that incandescence lamps ought to be started slowly, but also to leave off slowly. Incandescence diving lamps were used, but none of the arc description. The meeting then adjourned.

Berlin Physical Society, March 8th.

Dr. KAYSER showed a new electro-dynamometer constructed according to the directions of Prof. Bellati. Hitherto dynamometers consisted of two spirals—an external one, fixed, and an internal, movable, with bifilar suspension, which, being both successively traversed by the currents to be measured, produced a deflection of the movable spiral that was proportional to the square of the strength of the current. The technical difficulties attending the construction of these instruments were very great, and Prof. Bellati had therefore substituted for the inner spiral a bundle of annealed iron wires hanging to a cocoon thread inside the fixed spiral. Seeing the annealed iron wires possessed no residual magnetism, they were at once magnetised by any current and their deviation was likewise proportional to the square of the strength of the current. This dynamometer was highly sensitive with weak currents. An intercalated telephone, the membrane of which was feebly struck, gave deviations of from 60 to 80 parts of the scale—a sensitiveness which till then had been attained by no dynamometer. Dr. Kayser at the same time showed a globular dynamometer, after the design of Fröhlich, in which the inner spiral was coiled up like a ball, and a Siemens torsion dynamometer for strong currents in which the inner spiral was fixed, the outer movable, and the deviation read by a torsion apparatus. In the discussion which followed, the speaker stated that the measurements hitherto taken had proved great precision on the part of Prof. Bellati's dynamometer.

Dr. DIETERICI reported on the results of an investigation carried out by him in the last session into the electric residuum. The phenomenon had been experimentally examined by Prof. Kohlrausch, and theoretically treated by Riemann; but the formulæ set up by the latter did not correspond with the results of the experiments, and therefore the speaker undertook a new treatment of the subject. The experiments were carried out with a condenser, the lower plate of which was connected with the earth, the upper with a small mercury cup. A metal hoop led from the latter to a second mercury cup which on one side communicated through a metallic wire with one half of a quadrant electrometer, and on the other side through a second hoop with a third mercury cup. The second half of the electrometer and the third mercury cup were in permanent communication with the earth. The two hoops could alternately be raised out of the quicksilver by cords passing over a pulley or let down. If the first hoop were lifted up, the electrometer was conducted to the earth, the upper condenser plate, on the other hand, was isolated, and could now be charged. Thereupon the hoop was let down; the condenser now stood in connection with the earth and discharged itself. Finally, if the second hoop were raised, the condenser was connected with the electrometer, and both isolated. The residuum after the discharge could now be measured. The charge was effected by the highly constant dry Daniell cells (according to Herr v. Beetz), and in the different series of experiments the continuance of the charge was varied between five minutes and 24 hours, as the strength of the current was likewise varied. For each duration and strength of charge the residuum was determined in its course in respect of time in a series of individual determinations. The dielectric of the condenser was a paraffin plate and air. The experiments showed that under a charge of short duration—say, five to ten minutes—the residuum rose very rapidly with the time, and soon attained its maximum; so that its curve mounted very steeply and soon ran parallel to the abscissa of the time. Under a charge of long duration, again, the curve rose more slowly indeed; had, however, always greater values, and lay with more flat bend over the curve of short charge. On changing the strength of the current the electric residuum was always in proportion. Dr. Dieterici now treated the theory of the phenomenon, and briefly sketched the course of its theoretic investigation, which under the assumption that the dielectric was infinitely thick—that is, neglecting the influence of the thickness—led to formulæ which very well explained the experimental results. The formulæ were, however, only empirical; they did not allow the determination of the constants of the phenomenon. In conclusion, the speaker dwelt on the analogy of the electric residuum to the phenomena of heat, which had also under theoretic treatment found its expression by application of heat formulæ, and to the elastic after-effect which Prof. Kohlrausch had already pointed out.

NEW PATENTS—1885.

6445. "Methods of generating and applying electric currents to riders of velocipedes and other vehicles." S. MOODY. Dated May 27.

6470. "Devices and appliances for holding electric incandescence lamps." O. MARON. Dated May 27.

6485. "Machinery for raising and lowering telegraph or other cables." A. JAMIESON. Dated May 28.

6488. "Induction coils." W. P. THOMPSON. (Communicated by K. S. Dembinski.) Dated March 14. (Complete.)
6529. "Electric time pieces." W. P. THOMPSON. (Communicated by F. Baumann.) Dated May 29. (Complete.)
6554. "Telephonic circuits." S. P. THOMPSON. Dated May 29. (Complete.)
6555. "Voltaic batteries." T. J. JONES. Dated May 29.
6563. "Portable naval telegraphs and apparatus." J. G. LORRAIN. Dated May 30.
6574. "System of cables and apparatus intended to suppress telegraphic and telephonic induction." R. TAMINE. Dated May 30. (Complete.)
6608. "Electrical indicator." E. W. LANCASTER. Dated June 1.
6617. "Depolarising electric batteries." A. C. HENDERSON. (Communicated by E. Bazin.) Dated June 1.
6665. "Methods of or means for insulating electrical cables or apparatus, and methods or means employed therefor or therewith." J. S. WILLIAMS. Dated June 2.
6689. "Electric telephones." C. E. ALLEN. Dated June 2.
6691. "Conduits for electric light and other wires." H. J. HADDAN. (Communicated by E. D. Dougherty.) Dated June 2. (Complete.)
6750. "Method or device for preventing the noise caused by the vibrations of telegraph or telephone wires." H. J. HADDAN. (Communicated by R. E. Bardonnaut.) Dated June 3.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

7533. "Improvements in dynamo-electric machines and electric motors." G. HOOKHAM. Dated May 10. 6d. An armature is used having grooves in the iron in which the coils of the conductor lie. The iron of the armature passes very near to the pole pieces of the field magnets, and consequently the magnetic circuit is almost unbroken. The improvement consists in inserting a second armature in the magnetic circuit.

7699. "An improved automatic electrical current regulator." J. GILMORE and W. R. CLARK. Dated May 14. 6d. Consists of a bar composed of two diverse metals, having different degrees of expansion by heat, the bar being preferably of the constituents, nature, and form, or modifications of form, as patented jointly under number 563 and bearing date the 12th day of February, 1879. The main electrical circuit is carried round and round the said bar of diverse metals through a wire, of such a diminished section or of such materials, resisting electrical conduction to a greater extent than the rest of the main circuit, as to develop heat in consequence of such resistance, more readily at such part of the circuit surrounding the bar than elsewhere; and we may coat the said wire by a suitable envelope non-conducting to heat, so as to prevent its radiation and loss. The said regulating bar is mounted with one extremity a fixture upon a suitable stand, and with the other extremity free to move. Insulated upon the other moving extremity of the bar is fixed a double pronged metal foot, and the end of the main circuit wire wound round the regulator bar is attached thereto. The said foot rests with each prong upon an insulated contact piece of variable resistance; as for instance composed of strips of vulcanite, platinum, German silver, copper, &c., in order of their electrical conductive powers; the two contact pieces being arranged in inverse order, that is, both best, or both worst conductors are to the inside. The operation of our device is as follows:—When in its normal position with normal current flowing, the current passing through the wire coiled round the regulating bar does not heat the same appreciably, and the bar remains at rest with one prong completing the main circuit through the best conducting strip of metal of one contact piece, the other prong resting on the non-conducting strip of the shunt contact piece. When the current exceeds its normal force, heat is developed in the wire embracing the regulating bar, and is communicated thereto, causing a deflection of the bar by unequal expansion. The main circuit prong is thus moved from the best conducting strip of the one contact piece to a strip conducting in a less degree, and the other prong is moved from its non-conducting strip on the shunt contact piece to a strip conducting to some extent, and thus a certain proportion of the main circuit is diverted into an alternative shunt circuit, which may be utilised to ring an alarm bell, to regulate the speed of the driving engine if a dynamo is used, to pass into an accumulating battery, or to effect any other useful purpose.

8541. "Improvements in telegraphic and telephonic apparatus." D. SINCLAIR and J. L. CORBETT. Dated June 3. 6d. This invention is a further development of the improvements in telegraphic and telephonic apparatus, described in the specifications of Letters Patent No. 3380, dated 7th July, 1883, and No. 5964, dated 31st December, 1883. The leading features of improvement in the present invention, as distinguished from those above referred to, are the substitution of clockwork mechanism for the electro-magnets and ratchet devices formerly employed to

actuate the contact-making devices of the branch exchange instrument, which is used to place in communication any two subscribers on the telegraphic or telephonic system; and the imparting of an oscillatory or a to-and-fro movement in lieu of a rotatory movement to the contact-making disc or crown wheel, so that such device may be arranged in the form either of a straight bar or of a ring.

8573. "Improvements in electrical batteries." J. C. MEWBURN. (Communicated from abroad by C. B. De Montaud, of Paris.) Dated June 4. 6d. The improved battery, which forms the subject of the present invention, comprises essentially the following parts:—1. A vessel of metal, wood, earthenware, glass, or other suitable material, forming the positive pole, with a plate of carbon covered with oxide of lead, or an agglomerate of oxide of lead, or simply a layer of oxide of lead; when, however, the vessel is non-metallic, there will be in the bottom thereof a metallic plate serving as the pole, and having a rod which emerges out of the liquid. 2. A plate of amalgamated zinc, forming the negative pole. 3. As the exciting liquid, a basic solution at 30° Baumé, or an acid solution which will not dissolve the different oxides of lead.

8906. "Apparatus for the regulation of currents employed in telpher and other electric motors." F. JENKIN. Dated June 12. 8d. Has more especially for its object the regulation of currents employed in what is now termed the cross over system of driving telpher trains. The invention has three objects:—It does away with a dead point or dead length which has hitherto been inseparable from this system of driving; it substitutes a continuous current in one direction for a current which has hitherto been reversed at each section, and it regulates the speed of the motor and train; moreover it secures these objects without allowing any spark or voltaic arc to occur at any point in any circuit where it can be injurious. In a less complete form the apparatus avoids the dead length and regulates the speed, but lets the current be reversed at each section. In a still less complete form the apparatus simply regulates the speed of the train, and finally, by imitating one peculiarity in the cross over system of driving, this regulation of the speed becomes applicable to the system of driving a train by letting two contact pieces or brushes run along a positive and negative conductor respectively, and by an obvious extension can be applied to any motor whether driving a train or not; its use is in these cases confined to effecting the regulation without the introduction of an injurious spark, an object of much utility.

9113. "New or improved constructions of electrodes for primary and secondary batteries." J. S. BEEMAN. Dated June 17. 6d. One object of the invention is to overcome the short circuiting in batteries caused through the expansion of electrodes. Another object is to obtain a low internal resistance, and yet at the same time have sufficient space for the proper proportion of the electrolyte, and that the electrolyte shall be in free communication with the surface to be acted upon. Another object is, that all parts of the electrode shall have as equal as possible discharging or charging resistance. Another object is, that the electrode shall be sufficiently strong with a minimum of material to bear its own weight. The inventor takes a suitable and convenient plate, either flat or furnished with arms or wings or suitable projections either simply or folded together, and then by the aid of a saw or saws, or saw-like tool cuts or divides one or more of the edges or arms or projections into a fringe or hair comb like design, the portions forming this fringe being joined together through the continuous conductor at one extremity, but have the other extremity free to move.

9115. "An improved method of operating electrical switches to ensure positive make and break action of same." H. B. BOURNE and H. R. F. BOURNE. Dated June 17. 6d. The inventors provide the bridge or movable contact piece with one or more studs or pins which, when the bridge is moved, causes the stud or pin to press against and put tension on a spring attached to the bridge, so that after the bridge has passed a certain point the spring escapes an abutting pin, and causes the bridge to fly rapidly off and out of contact to break circuit, other pins being arranged that another movement of the bridge causes the spring to be put into tension, so that it can make a circuit.

9195. "Improvements in the production of plates or electrodes for secondary batteries." H. J. HADDAN. (Communicated from abroad by L. Epstein.) Dated June 19. 6d. In order to obtain a finely divided lead compound suitable for secondary batteries, a lead oxide or a lead salt is added to molten metallic lead, and the mass constantly stirred until it has been transformed from the liquid state into finely divided solid particles.

9211. "Improvements in arrangements of telephonic apparatus." S. P. THOMPSON. Dated June 20. 6d. Relates to the apparatus described in the number of the REVIEW for May 2nd, 1885.

9353. "A new or improved construction of brush for conducting and imparting electricity to the human or animal frame." W. TAPP. Dated June 24. 4d. The inventor constructs the "back" in the same manner as ordinarily for wood backed brushes, with the addition of a plate or plates of metal on its face (said plates forming positive or negative poles) with a division between to prevent contact between the wire bristles of the plates or portions of plate for conducting the electricity through the bristles or wire, or wire and bristles mixed, and said bristles or wire, or wire and bristles mixed, will be drawn through said plates. Between the plates he draws pure bristles into the wood

back instead of the bristles and wire before mentioned. Connected to the said plates are conducting wires which pass through the handle, and are provided with loops or other connections for connecting the brush to form the required connection either by means of a metallic cord or a cord of other electric conducting material with an electric machine or an electric or galvanic battery.

10215. "Improvements in tram cars and other vehicles propelled by electricity." A. RECKENZAUN. Dated April 12. 6d. The object of this invention is to provide means whereby the gearing and motors used for propelling vehicles by electricity are rendered self-contained and independent of the body of the car or carriage; and this is especially applicable to tram cars where two or more electro-motors are employed, as referred to in the provisional specification of invention number 6275⁸¹. For the purpose of carrying out his present invention the inventor employs either bogies or radiating axles. The motors with the gearing are supported on frames attached to the axles, and capable of moving with them.

14200. "An improved accumulator of electricity." J. MYERS. Dated August 25. 2d. The positive plates of the improved accumulator are made of carbon. They have a rectangular form with a slip on one corner, and are further prepared in the following manner:—The plate is not thicker than $\frac{1}{4}$ of an inch, and is perforated with six or eight holes, $\frac{1}{4}$ of an inch in diameter. The plate is covered on both sides with a layer of very subtle divided lead, prepared by reducing sulphate of lead by zinc in a solution of chloride of sodium, or by reducing white lead, minium or litharge by amalgamated zinc in a solution of chloride of sodium, mixed with a sufficient portion of pure sulphuric acid. Then the fine divided lead is pressed together. The so prepared plate is covered with parchment paper and enveloped in linen, cotton, flannel, or similar substance. The slips of the plates are plunged in melted paraffin. The negative plates are covered with lead or with zinc. They are of the same form as the positive one's, and are made of carbon, very thin copper, brass, white iron, zinc, or similar material. When they are covered with lead they are manipulated in the same manner as the positive one's. When on the contrary they are covered with zinc, at first narrow strips of India rubber plate, $\frac{1}{4}$ inch thick, are fixed on three of the margins on both sides of the plate, and then a good insulating material, as for instance: sarcinet, very thin gutta percha, American cloth, mackintosh, or similar material is folded over and attached to the three margins of the plate. Afterwards the plates are perfectly cleaned to receive the galvanoplastic deposit of zinc, from the solution of pure sulphate of zinc, with which the accumulator is filled. Having them covered with lead, the accumulator is filled with diluted sulphuric acid.

15365. "Process and apparatus for electroplating, and generally applicable for treating metallic surfaces by electrolysis." H. J. HADDAN. (Communicated from abroad by Dr. G. Wagener and C. Netto, of Tokio, Japan.) Dated November 21. 6d. This process has for its object to cover articles of any size with a pure metallic coating by galvanising or electroplating, and also to etch or oxidise the metallic surface of any article without immersing such article into the corroding liquid or "electroplating bath." For this purpose the article to be electroplated or oxidised is made to form the fixed pole of a galvanic battery, while the other pole together with the corroding liquid is made portable so that it may be conducted over the whole surface of the article and subject all parts of the same to the galvanising or electroplating action until the desired effect is attained.

15797. "Improvements in apparatus for regulating electric currents." W. H. SCOTT and E. A. PARIS. Dated December 1. 4d. There is suspended vertically by a spring and adjustment screw a soft iron core having at its bottom end a copper or iron plunger. This plunger dips into a hole or well containing mercury, formed in a number of copper or iron plates insulated from each other and bolted by a framing to a sole plate having in it a shallow well to form the bottom of the mercury well. The soft iron core passes through a solenoid having part of its length within that solenoid, so that as by the action of the varying of the current in the solenoid the iron core rises or falls, the plunger will in falling cause the mercury to rise in the well, or *vice versa*. By this action the mercury will as it rises short circuit resistances which are so arranged and connected to each of the series of copper or iron plates forming the mercury well as to effect this object. The solenoid may be wound either as a shunt or to be in series with the main current accordingly as it is desired to keep the E.M.F. or the current constant. In either case the movement of the plunger through the varying of the current round the solenoid will take out or put in resistances by the action of the mercury.

16728. "Improvements in electrical self-adjusting pendulum indicators." F. KING and W. P. MENDHAM. Dated December 20. 4d. This invention has reference to certain improvements upon the previous patent, entitled improvements in electrical self-adjusting pendulum indicators, No. 3473, and dated the 18th February, 1884. The inventors suspend the pendulum from the tips of two or more needlepoints as described in the above-mentioned patent. The cores of the electro-magnet they secure to an extension of the metal base in such a way that they point in an upward direction, i.e., the free poles of the magnet being uppermost. The armature they fix to the pendulum at such an angle, that upon the current circulating round the bobbins of wire a

side pull is given to the armature, the distance between the pole ends and armature being so regulated that the armature instead of being attracted up to the magnet and there in all probability sticking, as it usually does in this form of indicator, swings past without touching it, continuing the motion for the space of several minutes in virtue of the needlepoints from the tips of which the pendulum is suspended.

16735. "Improvements in means for communicating by electricity between moving trains and fixed stations, or between moving trains." H. J. ALLISON. (Communicated from abroad by L. J. Phelps, of America.) Dated December 20. 6d. The object of this invention is to dispense with the use of brushes or contact wheels carried by a vehicle and moving in constant contact with a conductor placed parallel to the way over which the car or vehicle travels either between the rails or upon poles beside the track (which is the plan hitherto employed for the purpose of communicating electrically with persons upon a moving railway vehicle), and to employ in their stead devices whereby currents in a line conductor parallel with the track or way may induce currents in a local circuit on the vehicle, or *vice versa* currents in the local vehicle-circuit may at any time induce currents on the line circuit.

16890. "Improvements in or connected with electric igniting apparatus for gas engines." D. S. REGAN. Dated December 24. 6d. Consists of a small dynamo worked by the engine, the current from which produces a spark between two metallic surfaces which alternately touch, and are separated from each other in the cylinder of the engine.

CORRESPONDENCE.

A New Cut-Out.

In your journal for the 11th of April, I find an illustrated article entitled "A new cut-out," suggested by Mr. Ruddle of the Edison Light Company, Manchester. Permit me to state that the idea is not at all new, it having been devised and used in a simpler form by Mr. E. R. Knowles, of Brooklyn, L. I., as part of the system of incandescent lighting invented by him for the Consolidated Electric Light Company, of New York. It has been in use for the past two years and has given perfect satisfaction during that time. No screw connections are used as in it the fusible link is soldered directly to the two springs on the plug cover, making a simpler and cheaper arrangement, and one which gives a better connection.

E. Richardson.

Piedmont Electric Illuminating Co.,
N. Y. City.

Gramme Arc Lamps.

I shall esteem it a favour if you will inform me who are the makers of the Gramme arc lamps in England, and, if possible, indicate the price they are quoted at? Is there any automatic cut out that has been successfully applied to these lamps? What is the cause, in your opinion, of the non-acceptance of these lamps in England and in America?

In Paris they are quoted retail at £14; such a price is prohibitory.

What is the nearest approach to these lamps in mechanism and steadiness? Those that I have seen on the Continent are absolutely perfect in their regularity, and I must confess that I have seen nowhere else a light that can equal it.

A Foreign Correspondent.

Barcelona, May 30th, 1885.

[We believe these lamps are still manufactured by the India Rubber, Gutta-Percha, and Telegraph Works Company of Silvertown, Essex. We cannot enter into the other questions put by our correspondent.—EDS. ELEC. REV.]

Trembling Bells.

Whilst appreciating the ingenuity of Mr. Jolin's electric bell, described in your issue of the 30th ult., I must confess that I fail to see the advantages to be

obtained over those which an ordinary "short circuiting" bell affords; whilst, on the other hand, the cost of construction must be increased by the application of the extra coils.

Then, again, though I do not wish to infer that the following is a new method, it may nevertheless be of interest to some of your readers if I describe a very simple yet effective arrangement which has been found to work satisfactorily on an alarm bell system, comprising, or rather including, 8 ordinary make and break bells, and about $\frac{3}{4}$ mile of line wire. All the bells were connected in series. Seven of the bells had their connections altered as though they were required for single stroke purposes (*i.e.*, the extremities of the coils were joined direct to the terminals, thus cutting out the make and break), the eighth bell was allowed to remain as it was, and the action of its "make and break" acted on itself and all the other bells, the result being a loud, clear, and regular action. There are other methods of working make and break bells for such purposes which are doubtless well known, such as connecting them on to "shunts" of the main line.

Arthur Edgar Cotterell.

Temple Chambers,
18, Temple Row, Birmingham,
June 1st, 1885.

[Our correspondent infers that the system he describes is not new; in this he is quite correct.—EDS. ELEC. REV.]

Referring to "Jolin's Improvements in Electric Bells," described in your last issue, it appears to me that the object of working several bells in series, on one circuit, could be attained with ordinary bells, by simply joining up the ends of the magnet coils of all the bells, *except one*, direct to the terminals—thus making the contact breaker of one master bell serve for all the series.

Of course all the bells should be the same size, or at least regulated to give the same stroke.

As to Mr. Jolin's bell not sparking, I do not see that it is any advantage, as, with platinum contacts, the wear and tear due to sparking is infinitesimal, and is more than counterbalanced by the saving in the battery, owing to the current being intermittent.

G. H. Bays, Jun.

June 1st, 1885.

[Mr. Bays will observe that another Correspondent has mentioned the same idea.—EDS. ELEC. REV.]

In your issue of the 30th ult. you state, in connection with Mr. Jolin's improvements in electric bells, that "hitherto it has been impracticable to arrange a system of electric bells in such a way and with such modifications of construction as will enable a number of trembling bells to be worked in series in one simple circuit, because as hitherto constructed such bells work by breaking the circuit during their vibrations."

The form of fire alarms supplied by the Exchange Telegraph Company to the Metropolitan Board of Works some years ago all contained trembling bells which worked without interrupting the circuit, and of which any number could be operated at a time on the same wire.

W. Fisher.

The Exchange Telegraph Company, Limited.
Head Offices: 17 and 18, Cornhill,
London, E.C., June 2nd, 1885.

The Membrane Telephone.

None are so blind as those who will not see, except, perhaps, those who persistently look at the wrong thing. Your correspondent, who shelters his identity behind the name of "Telephonist," appears to be suffering from the latter form of complaint. Not satisfied with my assurance that there is nothing claimed as new for the form of handle of the instrument on which he commented, he now finds fault with the

pole-pieces. He seems to imagine that the pole-piece of Prof. Thompson's instrument, the essential point of which is that it *does not* entirely surround the coil, is the same thing as the pole-piece of the D'Arsonval instrument, the essential point of which is that it *does* entirely surround the coil. My critic says that the Phelps instrument has no arrangement of the kind. He is evidently ignorant that there were several patterns of the Phelps receiver. He also appears not to know that Bell's patent of 1878 for this identical arrangement of concentric poles, afterwards used by Phelps and by D'Arsonval, is void on account of the stamp duty of £100 not having been paid. He first of all tells us that our instrument employs concentric poles, and then that the employment of such poles belongs to D'Arsonval. Both these statements only prove his own ignorance of, and inability to see, the most obvious facts.

As to the membrane, it is again entirely untrue that Prof. Thompson's instruments are constructed on the plan of Eldred's specification. "Telephonist" is equally reckless in his assertion that a membrane "cannot be manufactured or sold without infringing Eldred's patent." He would be a bold man who should assert that Eldred could in 1883 claim that which Bell described in 1876 and disclaimed in 1878.

Again, "Telephonist" is mistaken as to the plug arrangement; it has nothing to do with local batteries, but with line batteries—that is to say, with batteries which are in the main circuit or line wire.

Lastly, "Telephonist" appears to think that three Leclanché cells cost more than a magneto call instrument.

Would it not really be better if he would sign his letters with his own name than pretend to be a "Telephonist?"

T. W. Barnard, Secretary.

New Telephone Company, Limited,
4, Great Winchester Street,
London, E.C., June 2nd, 1885.

Jablochkoff's Battery.

M. Jablochkoff's idea of using a galvanic cell with three electrodes, described in the ELECTRICAL REVIEW of May 30th, is not altogether new, although his particular arrangement may be so.

In the spring of 1882 I constructed a small horizontal cell consisting of a plate of zinc placed at the bottom of the containing vessel, a plate of platinised carbon above but insulated from it, and, finally, a second plate of platinised carbon on top, also insulated. Connections were formed with the carbon plates by screwing carbon rods into them, the upper plate having a large hole in it to allow the rod of the middle plate to project through it. Sal ammoniac solution was poured into the vessel till it half covered the upper plate.

If the zinc be connected to the middle plate a current passes, and the latter electrode becomes hydrogenised. On interrupting this circuit, and closing that between the two carbon plates, a second current flows due to the well known Groves gas battery action. When the middle plate was well hydrogenised, this second current was sufficiently strong to ring a small bell for a minute or two.

I described the arrangement to some of my friends, but did not proceed with it, as it did not promise to be of practical use.

Legh S. Powell.

The Microphone.

If any one of your readers can inform me in what paper Prof. Hughes' microphone experiments were first published, and where I can obtain a full account of the same, I shall be much obliged.

"Enquirer."

June 2nd, 1885.

[Full descriptions of these experiments will be found in the Nos. of the REVIEW for May 15th, June 1st, Nov. 15th and Dec. 1st, 1878.—EDS. ELEC. REV.]

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